

1917

POISONING BY TRINITROTOLUENE (T.N.T.)

INTRODUCTION AND HISTORICAL REMARKS.

The manufacture of explosives in this country is an industry of very considerable importance and from all points of view economic, industrial, engineering and military it is worthy of close attention.

The appallingly destructive effects of an explosion are caused by the almost instantaneous conversion of the solid explosive into gases at a very high temperature, with the simultaneous exertion of enormous pressure - to which must be added the asphyxiating action of the same gases.

TRINITROTOLUENE is one of the most recently developed of high explosives and though it has been manufactured and used for some years ^{it} was not until the present war that it came into such prominence.

At the beginning of the war it was discovered that it was being used in German torpedoes.

The letters T.N.T. were found printed on the sides of captured torpedoes.

Trinitrotoluene is now extensively used in the filling of bombs, shells, hand-grenades, torpedoes, etc.

In the filling of shells it has to a great extent replaced picric acid for that purpose.

T.N.T. has greater stability and ^{less} sensibility to shock, also it is not an acid substance and does not attack metals or their oxides; consequently it does not form highly sensitive salts and is thus much less dangerous than Picric Acid.



2. Introduction, etc.

Other names such as Trotyl, Trinol, Tritolo and Tritol have been given T.N.T. and it is known as Tolite in France and Trilit in Spain.

Trinitrotoluene is a nitro explosive belonging to the Benzene Group and is hence a coal tar product, and therefore similar in origin to Aniline, the basis of Aniline Dyes.

Toluene is Methyl Benzene $C_6H_5CH_3$ and T.N.T. is obtained by nitrating this substance by a mixture of nitric and sulphuric acids.

Toluene (sometimes incorrectly called Toluol) is a colourless liquid and is obtained by the fractional distillation of coal tar - a by-product in the manufacture of coal gas. -

It is lighter than water, having a sp.gr. of .8824 and it boils at $110^{\circ} C$.

PREPARATION.

~~Preparation~~ In the manufacture of T.N.T. 180 parts by weight of pure toluene are run into a steam jacketed steel nitrating vat.

Then a mixture of 315 parts by weight of H_2SO_4 (sp.gr. 1.84) and 200 parts by weight of HNO_3 (sp.gr. 1.44) is admitted.

This reacts with the toluene and produces

Mono-nitro-toluene.

when the reaction is complete the waste acids are drawn off.

The mono-nitro-toluene remains in the nitrating vat and a fresh mixture of acids (600 parts by weight H_2SO_4 and 200 parts by weight HNO_3) is now run in and the resulting mixture is heated and kept agitated.

3. Introduction, etc.

This converts the mono-nitro-toluene into

Di-nitro-toluene.

The nitrating operation is repeated when Tri-nitro-toluene is obtained, the formula of which is $C_6H_2(NO_2)_3CH_3$.

It is very insensitive to blows and remains stable when exposed to the air for long periods.

It is a solid at ordinary temperatures and its melting point is $72-77^{\circ}C$. and the sp. gr. is 1.54 to 1.58.

T.N.T. is only slightly soluble in hot water but will dissolve in ether, benzene and acetone. It is pale yellow in colour and has no taste. It was thought to be non-poisonous and less injurious than Picric Acid, but attention was drawn to its poisonous nature by the occurrence in 1915 of a fatal case of toxic jaundice in a worker employed in filling shells with T.N.T. Other cases of more or less severe illness also occurred among such workers.

In 1908 T.N.T. was included in the schedule to the regulations drawn up to control the Manufacture of the nitro and amido derivatives of benzene; although T.N.T. is not in the heading it is included in Schedule A.

Previous to 1915 there were no known cases of poisoning due to the use of T.N.T. in the filling of explosives.

At the time the regulations were drawn up only a small percentage of T.N.T. was used (and in a dry condition) in explosives, intended for blasting operations in mines and quarries.

The Secretary of State's order dated Nov. 27th, 1915, added Toxic Jaundice from T.N.T. to the list of diseases (poisoning by lead, phosphorous, arsenic, mercury or anthrax) to which, when contracted in a factory or work-shop,

section 73 of the Factory and Workshop Act 1901, applies.

From the above it is seen that the toxic effects of T.N.T. are not notifiable unless jaundice is present.

ETIOLOGY.

Poisoning by T.N.T. may be brought about in three ~~ways~~ ways:

1. Ingestion
2. Inhalation
3. Absorption through the skin.

Nitro compounds act on the blood more or less in the same way no matter how they are absorbed.

Probably absorption from inhalation of the vapour is the commonest, but it would seem that absorption through the skin is fraught with most danger.

It is said that poisoning is more prevalent during the hot weather, but my experience does not confirm this, except in as far as skin affections are concerned.

Direct absorption through the skin plays an ~~impo~~ important part and the T.N.T. or its compounds pass directly into the superficial blood vessels. Probably they dissolve out the fatty covering of the skin and thus enable the poison to reach the capillary vessels below.

Excessive sweating and consequent softening of the skin is said to favour absorption.

Absorption through the alimentary canal is more rapid if the stomach is empty, and malnutrition increases the susceptibility of the workers.

Women ~~dox~~ not appear to be more susceptible than men, and the sexes seem to be equally affected by the poison.

5. Etiology.

Persons of immature age and those debilitated from any cause are liable to be injuriously affected by T.N.T.

Persons under 20 and over 50 are believed to succumb sooner than those between 30 and 40 years of age.

Those who are unclean in person and lack care are also susceptible.

Persons who omit to ~~change~~ their working clothes on returning home or who sleep in their day clothes are specially liable to absorption, as the T.N.T. remains on the skin and on the under-clothing, and so "contact" goes on, the skin acting as ^areservoir from which gradual absorption takes place.

The permeability of the skin of different individuals varies very much, and this may account for the fact that some persons are more susceptible than others. While persons of fair skin appear to suffer more from dermatitis, they do not appear to be more liable to toxic or poisonous effects than those of darker complexion.

It is an interesting fact that there is a pink discoloration seen on the underclothing of those workers who ~~sw~~ sweat profusely, and where the skin or hair is exposed to contact a yellow or picturesque bronze colour is produced.

The pink colour on the underclothing is probably due to the fact that the nitro salts of toluene (which are neutral salts with an acid reaction) combine with an alkaline base such as soda, potash or lime (soap or washing soda left in the clothing during the process of washing)

The varieties of colour (from yellow to bronze) on the skin are probably also due to the action of soap.

Similarly the finger nails are usually of a canary colour

6. Etiology.

The staining of the integument may last for some weeks after removal from contact with T.N.T. and this staining is characteristic of all operatives who manipulate this explosive.

Persons with previous gastric or liver troubles and alcoholics are more susceptible and also persons with ~~more~~ lowered vitality from any cause, e.g. long hours, malnutrition, over-fatigue, etc.

In a large proportion of the cases who came up for treatment it was found that they lived quite a distance from the factory, many taking one hour or $1\frac{1}{2}$ hours to come to work and others taking 2 hours from the time they left their home until they reached the factory. These persons therefore lost 3 or 4 hours each day from time which could have been more profitably spent in resting or sleeping.

Notwithstanding all efforts (such as improved ventilation, periodical medical inspection, careful washing after work, the ~~x~~ wearing of overalls and gloves, alternation of employment, the provision of suitable and sufficient food) the workers have not been entirely safeguarded. For it is found that even with all these precautions when there is a large number of workers employed there is always a proportion who will show signs of poisoning, and these by no means always those who, due to obvious ill health or malnutrition might have been expected to succumb. Also the cases of poisoning ~~don~~ not always come from the buildings where there is most fume or dust.

One is therefore driven to the conclusion that in these cases there is some personal idiosyncrasy at work.

7. Etiology.

Another factor worthy of note is, that there is no definite relationship between the severity of the symptoms and the ultimate issue of the case.

One case may present certain severe symptoms and yet make a complete recovery in a short time.

In other cases the onset may be insidious and gradually progress to a state where no remedy seems to be of any avail.

Sometimes the workers who are suffering from dermatitis of face or hands due to T.N.T. complain that they have infected their wives and frequently ask if the rash is infectious. The explanation is probably found in the fact that the men's working clothes which are contaminated with T.N.T. powder are washed by their wives, thus setting up a dermatitis of hands and faces.

Another phenomenon observed in patients admitted to hospital suffering from dermatitis is that when the patient is discharged from hospital much improved or apparently cured, in many cases he returns (often within 24 hours) with the dermatitis as bad or worse than ever. This recrudescence of the disease may be due to the irritation of the hair or indiscretions in diet or much more likely to the irritation and absorption of T.N.T. remaining in their working clothes.

(During their stay in hospital the patients do not wear their own clothes but special hospital clothes, and they receive their own clothes on discharge from hospital.)

MORBID ANATOMY & PATHOLOGY.

The post mortem appearances of T.N.T. cases are very characteristic. The bodies are usually well nourished but in the case of the boy hereafter referred to as Case No. 9, the body was emaciated, but this appears to be the boy's normal condition.

All the cases ~~where~~ where death supervened have belonged to either of two types: - , anaemic or icteric - No fatal case of the cyanotic type has been reported.

ICTERIC TYPE. Macroscopic appearances.

The skin is of a lemon yellow or of a greenish yellow colour. This is easily distinguished from the staining of the hands and face due to actual contact with the T.N.T. powder. All the tissues and organs are stained the same lemon yellow colour.

No haemorrhages have been observed in the skin.

On incising the chest and abdomen the rib ~~cartilages~~ are seen to be stained yellow.

The intercostal and abdominal muscles are deep red.

The liver is not visible beneath the costal margin. The liver is sometimes adherent to some of the surrounding organs. In one case it was adherent to the intestines and firmly adherent to the diaphragm and also slightly to the Parietal Peritoneum.

The liver is very small and markedly reduced in weight. The following have been the weights of some of the livers examined:

Woman adult; 29 oz.

Woman adult: 26 oz.

Woman adult: 30 oz.

Boy, aged 14: 20½ oz.

It is from a brownish yellow to a dark red in colour.

9. Morbid Anatomy & Pathology.

It is soft and flabby with rounded margins, but where there are sunken areas the margins are sharp. It shows distinct lobulation and on the surface there are seen prominent masses or groups of raised nodules. These nodules may be cauliflower like or may be only slightly raised. The lobules have a red centre and a yellow periphery.

Where the areas are sunken the capsule over them is ~~af~~ opaque and only in a few cases can the lobular pattern be made out. Such lobules are small and have a red centre and yellow periphery. The lobules and their yellow zone are much smaller than in the raised nodules.

The orifices of the hepatic ducts are patent.

On Section the raised areas on the surface correspond to areas of hepatic tissue in which the lobules are large soft and bulging, and separated by narrow slatey gray lines. The latter evidently correspond to portal systems. In places, the centres of the lobules are deep red.

The sunken tissue on section shows an indistinct lobular pattern, there being numerous closely set slatey gray portal systems in a mahogany ground.

The degenerative cirrhotic process is practically always most advanced in the left lobe, the least damaged portion of the liver being the anterior part of the right lobe.

The Kidneys are rounded soft and flabby, and are usually larger than normal probably owing to the pathological changes. The capsule is smooth and transparent showing a smooth yellow surface (in one case the kidney was dark in colour with a slightly yellowish tinge) on which stellate vessels are visible.

There are no adhesions and the capsule strips readily.

On section the cortex is greatly bulged. The demarcation is sharp between cortex and medulla. The relation of the cortex to the medulla is 1 to 2 or less than 2.

The pattern is straight, the labyrinth being bright yellow and speckled; the pyramids being narrow and slatey in colour.

The medulla is pale yellowish pink and the vasa recta red.

The pelvis is small and smooth and the ureter is not dilated.

The Supra renals. The cortex is yellow with a brown pigmented zone. The medulla is scanty and is of a slate colour.

The Spleen. is usually larger than normal, probably owing to its being engorged with blood. (In the P.M. mentioned the spleen was small).

It cuts firmly, and the cut surface shows a slightly chocolate to red tinge.

The trabeculae are distinct and the malpighian bodies are small and indistinct.

The Pancreas is slightly flabby and is stained ~~pink~~ on the surface like the other organs. It shows no sign of softening, and the lobulation is distinct, the lobules being about the size of ^a/pin head.

The Gall Bladder may be small and collapsed, or if not, on compressing it a little thin creamy fluid is exuded followed by cloudy pale green fluid.

The Bile Duct is patent.

The Stomach. may contain black fluid. The mucous membrane of the dependant portion of the body is smooth, thin and gelatinous. The remainder of the mucosa is distinctly granulated. There may be some pin point petechiae.

The Intestines show injection of the blood vessels with petechial haemorrhages.

The duodenum has injection of its vessels. There is yellow chyme in the ileum and altered blood in the jejunum with clay, ^{coloured} almost white faeces in caecum.

The Peritoneum as a rule shows a large number of haemorrhages. This is the rule, although the case mentioned does not ~~se~~ show this.

In the gastro-hepatic and great omentum there are numerous small haemorrhages. There are small petechial haemorrhages and injection of vessels in the appendices epiploicae, throughout the mesentery and along the attachment of the colon.

The Inferior Vena Cava may be thrombosed.

The Mesenteric glands are deep red in colour and show no enlargement.

The Heart usually normal in size is flabby and the surface slightly discoloured.

The Valves are thin and transparent, and the Endocardium is stained lemon yellow. There are pin ~~point~~ head haemorrhages in the endocardium of the left wall of the interventricular septum.

The heart muscle is flabby and the cut surface bulges slightly and is of a café'au lait colour.

The Pericardium shows some petechial haemorrhages especially around the origin of the great ~~in~~ vessels.

It may contain some dark amber like or bile stained fluid. There are usually no adhesions.

The Lungs are usually normal but there may be haemorrhages on the surfaces of both lungs.

There may be ~~pin~~ pneumonic patches at the bases and in

other cases fine raised gray areas of peribronchial consolidation. Both the parietal and visceral pleura may have minute haemorrhages. There is no effusion of fluid into the cavities but adhesions may be seen.

The Trachea may contain bloody froth.

The Bronchi may be injected and congested but the bronchial glands show no enlargement.

The Oesophagus is normal but in one case the ^{mucous membrane} ~~skin~~ was desquamated from the lower half and there was yellow fluid in the crypts of the tonsils.

The Tongue is furred and of a lemon colour. The muscle of the tongue is pale with a distinct yellow tinge.

The Thymus in adults is ~~minimally~~ completely replaced by fat in which are many haemorrhages.

The Cervical Glands are deep red externally and on section.

The Brain is normal ~~and~~ in weight and the anatomical pattern is normal. The dura on the outer surface is of a distinct yellow colour. The vessels are engorged and from the cut surfaces blood rapidly effuses. There may be clots of blood in the superior longitudinal sinus and also in the other sinuses.

There is slight bile staining of the

~~Vellum~~ Interpositum but no icter^us of the cerebral tissue itself.

The cranial nerves are white and equal and show no change.

There are no cerebral or men^uigeal haemorrhages.

13. Morbid Anatomy & Pathology.

The Blood Vessels. There are raised yellow ridges in the Interna of the left common carotid and a few pin point yellow lobules in the origin of the left subclavian. A few small indistinct powdered patches in the ascending and descending thoracic aorta, and a few minute fat flakes in the upper abdominal aorta.

There is deep bile staining of the

Synovial Fluid of the joints.

In the Femur there is red marrow in the upper $\frac{3}{4}$ of the diaphyses in adults.

MICROSCOPIC APPEARANCES.

LIVER: In the centre of the lobule around the central vein is a zone in which hepatic cells are absent. The zone is usually haemorrhagic, corresponding to the deep red centres seen naked eye.

The capillaries are separated by interstitial tissue. Next this central zone is an intermediate zone in which the hepatic cells are visible. These cells are necrosed, their nuclei being absent.

Outside this is a peripheral zone in which the columns of hepatic cells are nucleated. The cells are enlarged the protoplasm showing cloudy swelling. A considerable number of the cells which lie next the previous zone contain large globules of fatty substance.

The intercellular canaliculi are frequently distended by bile.

The portal systems are infiltrated with extremely numerous leucocytes.

Morbidity Anatomy, & Pathology.

In the portions of the liver which show greater destruction than the above it is seen that the necrotic intermediate zone extends further out, and from the bile ductules in the portal system there pass branching strands of cells which have the appearance of "pseudobile canaliculi". The centres of the lobules are destroyed more readily than the peripheries.

The Kidneys. The interstitial tissue of the glomerular tufts is swollen. The cells of the convoluted tubules, ascending limbs and descending limbs of Henle and the collecting tubules show extreme fatty degeneration and fragmentation of the nuclei. In some cases there is considerable necrosis. Some of the tubules contain bile stained debris. There is no active inflammatory reaction.

In one case there was cloudy swelling, and no fatty degeneration.

The Pancreas. shows fatty degeneration of the ductules of Bell and centro-acinar cells, also of the epithelium of the duct of Wirsung, and to a small extent of acinar cells.

The conditions described are primarily due to the effect of the nitro-derivatives upon the blood.

On pricking the ear the blood has sometimes a characteristic colour - it is darker than normal -

The poison probably acts by converting the oxy-haemoglobin of the R.B.C. into methaemoglobin and then haemolyses them causing degeneration of the cytoplasm and escape of the haemoglobin into the plasma.

After solution of the R.B.C. the freed haemoglobin reaches the liver where it is converted into bile pigment.

The haemoglobin remaining in the blood becomes converted into ~~methaemoglobin~~ methaemoglobin to the presence of which is due, according to the degree of change, the ashen gray or cyanotic colour of the lips and complexion.

The power to take up oxygen from the air in the lungs is more and more lost, and the ^{symptoms} ~~systems~~ of dyspnoea or air hunger so constantly present in marked attacks is produced. This ~~unoxgen~~ unoxygenated blood acting on the liver and kidneys will cause necrotic and fibrotic changes in the cells and connective tissue.

A cholangitis is set up in the small intrahepatic bile ducts by the poisons excreted from the blood, as a consequence of this there is obstruction to the outflow of bile and ~~jaundice~~ jaundice is produced.

A good example of this type of jaundice is shown by the experiments of Hunter with Toluylenediamine.

This poison, when introduced into the circulation, gives rise to the destruction of the R.B.C. with liberation of haemoglobin (haemolysis), and to jaundice. At first there is an increase in the flow of bile owing to the amount of free haemoglobin reaching the liver.

Later the amount of bile secreted diminishes and the bile becomes more viscid until finally the flow of bile becomes almost arrested. This slowing and diminution in the flow of bile is found to depend on inflammation of the smaller intrahepatic bile ducts which become swollen, secrete thick mucus and are in a condition of catarrhal cholangitis due to the toxic effects of the toluylenediamine

This jaundice is toxæmic and depends on the presence of a poison in the blood which sets up inflammatory changes and consequently obstruction in the small intrahepatic ducts.

The Anaemic Type.

Macroscopic.

The body is not emaciated. There is great pallor and no jaundice.

16. Morbid Anatomy & Pathology.

Purpuric spots are observed on various parts of the body, and there may be haemorrhages into the conjunctiva and iris.

On opening the body haemorrhages are also observed on most of the serous surfaces.

There is very little blood in the body and it is very pale and watery.

The Heart is enlarged, fatty and dilated.

The epicardial fat is large in amount and the heart muscle shows fatty degeneration. This degeneration is not distributed uniformly, giving the appearance of tabby-cat striation or tigering.

Some fatty patches may be observed in the aorta.

The Lungs are pale and oedematous and parts of them may show oedematous collapse.

Hydrothorax in varying quantities is generally seen.

The Liver is normal in size or slightly larger than normal.

It is rusty brown in appearance being very like that of pernicious anaemia with iron in excess. The iron being loosely combined in the cells of the outer and middle zones of the lobules.

The Spleen is small but normal in appearance, and there is nothing of importance to note macroscopically.

The Kidneys are enlarged, anaemic, oedematous and show fatty degeneration.

The Stomach is pale and as a rule shows mucous catarrh.

The Brain is anaemic and oedematous and has very many capillary haemorrhages. These petechiae in one case were most numerous in the cerebellum.

17. Morbid Anatomy & Pathology.

The Bone Marrow shows the greatest change. Instead of the red marrow in the long bones which one would expect from such severe anaemias, there is a complete atrophy of the ~~bonyx~~ marrow, and the marrow is pale in colour and practically fatty throughout.

The differences of the bony marrow in these cases from those found in pernicious anaemia are very striking.

MICROSCOPIC.

The Liver In the centre of the lobules there is fatty degeneration and necrosis, and the hepatic cells in the peripheral zones are loaded with granules of free iron.

The appearances under the microscope are very like those found in pernicious anaemia where the iron is seen in the cells of the outer and middle zone of the lobules.

The iron being accumulated on the side of the cell next the bile capillaries and not next to the blood capillaries.

The Kidneys show parenchymatous necrosis and fatty degeneration with some granules of iron.

The Spleen looks normal and has a considerable number of cells containing coarse granules of iron.

The Brain shows fatty degeneration of the endothelium of the capillaries.

The Blood Forming Marrow of the bones show a relative excess of erithroblastic activity and a great decrease of megakaryocytes.

In the marrow there are numerous plasma cells and large phagocytes. The latter contain pyknotic nuclei, erythroblasts, erythrocytes and coarse granules of iron pigment.

THE CLINICAL FEATURES, SIGNS AND SYMPTOMS.

The injurious effects of T.N.T. on persons employed in handling this explosive are seen in different forms. They may be divided into two main ~~main~~ classes.

I. General or Constitutional.

II, Local.

I. General or Constitutional may be further subdivided into

(a) Cyanotic, (b) Icteric, (c) Anaemic.

(a) Cyanotic

The greater number of patients belong to this type and fortunately it is the most amenable to treatment.

The symptoms are easily recognised when the ~~patient~~ patient has not been disturbed, especially to those who have experience in dealing with such cases.

There is a typical T.N.T. facies, a pale anaemic face, lacking in expression. The lips and gums are ashen blue in colour (This blue colour tends to disappear if the patient becomes excited e.g. by examination) and there is often a trace of yellow in the conjunctivae long before there is any on the skin where it is not exposed to contact with T.N.T.

S Y M P T O M S A N D S I G N S .

The symptoms described may come on gradually after several days' or weeks' work, on the other hand they may appear quite suddenly.

Of the cases which come before the Medical Officer what is most commonly complained of are "pains in the stomach". At least this was the most frequent symptom in my own series of cases.

19. Clinical Features.

I shall therefore describe first the effect of T. N. T. on the alimentary system.

As a rule there is a metallic bitter taste in the mouth, most of the workers complain of this constant bitter taste. I have sometimes felt the bitter~~taste~~ myself when on a visit of inspection, but the taste in the mouth when inspecting workers on picric acid is much more marked.

The appetite is impaired and there is often complete loss of appetite. In some cases the appetite is increased and the worker can eat more. These workers inform the Medical Officer^A at weekly inspection that they feel better when working on T. N. T. They also improve in appearance, probably due to the increase in appetite.

The " pains in the stomach " vary from a sharp ripping pain in the region of the Xiphisternum to a dull ache or sinking sensation in the region of the stomach. (Sometimes the pains are in the intestines and are of a colicky^A nature) This is a very common complaint and as a rule has no relation to food. The pain is sometimes spasmodic in type and intermittent, and is at times accompanied by nausea. The nausea may be followed by vomiting. Some of the patients say that they " ~~xxx~~retch " but that no food comes up"

The vomit is intensely bitter and of a greenish yellow colour - it is a bilious vomit -.

Acid eructations are also frequent. Flatulence and distention may also occur and constipation is a very constant symptom. Some of the cases of constipation may be due to the fact that the workers are employed for a fortnight at a time alternately on night and day shifts.

Instead of constipation some of the workers suffer from diarrhoea. This diarrhoea is often accompanied by pain and tenesmus, but it is not a constant symptom.

The tongue is as a rule clean and moist even when the gastric symptoms are very acute, and it may be tremulous. As a general rule there is no tenderness in the abdomen although it is occasionally observed. Tenderness over the liver is more common.

The Circulatory System.

The principal symptoms under this head are faintness and giddiness; one man said he had a "dizzy feeling" ever since he had started on T.N.T.

Collapse is sometimes complained of, and two of my patients told me that they were unconscious for a time.

Occasionally palpitation is experienced and shortness of breath on walking, one man described it as a "catching of the wind". Patients have also described hot and cold flushes.

The chief signs are anaemia and cyanosis. These are very important and the inspecting Medical Officer should always be on the look out for them. Many workers present one or other, and sometimes both of these signs when they do not think it necessary to visit the doctor. Hence the necessity for periodical visits to the factory by the medical officer.

The type of anaemia in these cases is not of the pernicious variety, but it is sometimes very profound. However, it fortunately improves fairly rapidly under treatment. Sometimes the complexion is very pale, yet on examination of the conjunctivae there are no signs of anaemia.

Cyanosis is another frequent sign, this may be very slight and in other cases the lips may be very blue.

An ashen gray colour of the lips is very typical, and sometimes the lips and tongue are deeply cyanosed.

In these cases of deep cyanosis I could never discover any cause for it in the condition of the heart.

21. The Clinical Features.

The pulse rate in the majority of my cases was normal. I have seen bradycardia described but this has not been my experience.

Swelling of the hands and feet may occur but this is usually associated with dermatitis of these parts.

The Blood .

In the cyanotic type of the disease the cases which I have examined have been practically normal in blood count (red and white) also the corpuscles have acted in the usual way to the different staining fluids used.

In places where T.N.T. is manufactured and where the workers are liable to come in contact with dinitro-benzene and dinitrotoluene there is usually ~~severe~~^{observed} severe destruction of the R.B.C. In these cases the R.B.C count is very low e.g. 3,000,000, and there is also great variety in the sizes of the R.B.C. and sometimes pokilocytes are found. I have not found any of these changes in the blood of any of the cyanotic patients who were engaged in the filling of T.N.T.

The Respiratory System.

The symptoms include nasal discomfort, sneezing and catarrh. There may be occasionally bleeding from the nose.

Burning and smarting of the eyes may occur in conjunction with the above, but these symptoms are usually associated with dermatitis .

The throat may feel tight and sore, this sometimes gives rise to cough.

The chief symptom which causes the worker to seek advice is a feeling of " tightness in the chest " by some described as a " pain in the chest ". It has also been

described as a "raw feeling in the centre of the chest!"

Sometimes a feeling of intense suffocation is complained of and the patient feels like "fighting for ~~his~~ breath." A dull pain at the back of the shoulders has been described to me.

The Nervous System. Frontal headache is a very a common symptom, and this is sometimes accompanied by pain at the back of the eyes. This frontal headache may probably in some cases be due to nasal obstruction caused by the action of the T.N.T. on the mucous membrane of the nose. Headache has been known to appear in 24 hours, as in case 27.

Drowsiness is also common and in some cases there is a feeling as if one were drugged.

Lassitude is complained of - as one worker put it - "he was not so brisk"

Depression and apathy are sometimes felt. Cases occasionally collapse and become unconscious for a time. One man said that he had a slight frontal headache before fainting.

Blurred vision and transient loss of memory have been met with.

Pain in the back of the knees and aching of the legs and ~~and~~ a numb feeling in the legs have been complained of, but I have never seen any true case of peripheral neuritis in my patients such as has been described in cases of dinitro-benzene ^{and} dinitro-toluene poisoning.

23. The Clinical Features.

The Urinary System.

The urine is darker coloured than normal and there may occasionally be scalding on micturition.

Unless there is some kidney disease present no albumen will be found.

A remarkable phenomenon is that occasionally the urine will reduce Fehling. One case No. 43 had sugar in the urine when he was first admitted to hospital, and in this case sugar was detected only once, although the urine was tested frequently afterwards at all hours it never gave a sugary reaction.

Case No. 52 was also remarkable as he had intermittent glycosuria. This man said that he had never anything wrong with him in that respect, still he may have suffered from diabetes before this.

A point observed in testing the urine of persons in contact with T.N.T. is that there is often a distinct reaction with ~~the~~ nitric acid in the cold, similar to but less intense than that which occurs in jaundice.

This probably shows that T.N.T. or one of its ~~de~~ derivatives is being excreted through the kidneys. The difficulty in detecting T.N.T. is that it becomes combined in the body in a reaction which changes it for the time being, once it has passed into the system and been dealt with, it is no longer taken up by its well known solvents, and must be set free before it can be recognized by its chemical tests.

I have used Webster's test for some time previous to and after the date of publication and have found that the presence of T.N.T. in the urine can be detected in the manner described.

24. The Clinical Features.

((Webster's Test for Presence of T.N.T. in Urine. *Ref vii*)

Measure out $12\frac{1}{2}$ ccm. of the urine in a measuring cylinder, then add $12\frac{1}{2}$ ccm. of diluted sulphuric acid, made up by mixing 20 ccm. of strong sulphuric acid with 80 ccm. of water. Pour the mixture of urine and acid into a separat^{ing} funnel of 100 to 150 ccm. capacity and provided with a stopcock; add to the mixture 10 ccm. of ethylic ether (the ordinary ether made from methylated spirit is sufficiently pure for the purpose), shake up well and allow to settle; take out the cork or stopper from the top of the separating funnel, open the stopcock at the bottom and allow the mixture of acid and urine to run off, then turn the stopcock off so as to retain the ethereal solution in the separating funnel. Now add 25 ccm. of tap water to the ethereal solution in the separating funnel and shake up again to remove the traces of the mixture of urine and acid, and allow to settle again for two or three minutes, then run off the water by opening the stopcock, retaining the ether in the funnel. Finally, let the ethereal solution flow into an ordinary test-tube and try for the presence of T. N. T. as follows:

Prepare a solution of alcoholic potash by dissolving 4 to 5 grams of caustic potash ⁱⁿ ~~in~~ 100 ccm. of methylated spirit or absolute alcohol. Where many tests are to be carried out this solution may be made by having a stock saturated solution of caustic potash, and adding, when a fresh quantity of the reagent is required, 10 ccm. of this to 90 ccm. of alcohol.

To the ethereal solution obtained as above described 5 ccm. of this alcoholic solution of potash

25. The Clinical Features.

are added. When T.N.T. is present a purple coloration is at once developed, varying in intensity according to the amount of T.N.T. present,, from the faintest trace to a deep purple. The colour changes rapidly from the purple to a brown colour, and it has been found that the best results as to intensity are obtained by judging rapidly after the colour is struck."

The intensity of the reaction varies with the presence of other bodies in the urine, but ⁱⁿ nearly all the urines of workers on T.N.T. the presence of T.N.T. can be demonstrated. The disadvantages in connection with this test are, that a person suffering from rather severe symptoms of T.N.T. poisoning may give a ~~poor~~ reaction with Webster's test, whereas the urine of a person who is obviously not suffering may give an intense colour reaction.

However, the test is very useful when employed in conjunction with a careful consideration of the other clinical signs and symptoms.

General and Special Symptoms.

In women irregular and scanty menstruation, as much as 34 per cent of the workers, has been observed.

Loss of weight may occur, but this may be partially due to the vomiting and loss of appetite.

(b) ICTERIC TYPE.

This is the next most frequent type and is very insidious in its onset.

There are comparatively few symptoms until the patient is suddenly jaundiced.

The symptoms at first are very like those of the cyanotic type just described, and there is very little

26. The Clinical Features, Symptoms & Signs

to distinguish the two types until the jaundice somewhat suddenly supervenes.

The chief premonitory symptoms are, pains in stomach, nausea and headache. These, as a rule, appear about four weeks after commencing work on T.N.T., they sometimes appear as early as two weeks. Later, jaundice appears and that ~~quinn~~ often quite suddenly. In some cases the worker may still be employed while jaundiced (and feeling fairly well) and the case be detected for the first time by the Medical Officer on his visit to the Factory.

Another condition worthy of note is, that ~~the~~ jaundice may develop although the worker has been removed completely from contact with T.N.T. In the case No. 9 he had been removed from T.N.T. for some days before jaundice was noticed.

The Alimentary System.

There is as a rule a bitter metallic taste in the mouth with loss of appetite, but often the appetite is very good at first.

Pains in the stomach, slight at first but gradually getting worse. The pains are very like those described in the cyanotic type.

Nausea and vomiting of green sour fluid may occur. At first there may be nausea but no vomiting. Towards the end the vomiting may be well marked and there may be haematemesis.

Sometimes the abdomen is swollen and tense and there is always present constipation.

The Jaundice in these cases is both conjunctival

27. The Clinical Features.

and general and is well marked. It rarely appears earlier than the four/th week of employment and it may be delayed in its onset. In case No. 9 it did not appear until about 7 weeks from the commencement of work on T.N.T. and the appearance of the jaundice may be delayed much longer than this.

During the progress of the case the depth of the jaundice varies, but it usually becomes more intense before death.

The Liver is usually normal in size at the commencement, and there is no tenderness in the abdomen. The upper border when examined in adults being at the fifth rib and the lower border at the costal margin. However, as the disease progresses the liver may increase in size. I was able to observe this phenomenon with great interest in case No. 9., When examined on 16.2.16 the liver was not enlarged (the lower border was at the costal margin). On the 27.2.16 the liver was $2\frac{1}{2}$ inches below the costal margin in the mid-clavicular line. On the next day the jaundice was more intense. On the 29.2.16 the liver had increased another $\frac{1}{2}$ of an inch.

Later the liver decreased in size, and gradually got less until the patient died.

In any of the cases which I have seen in the literature on the subject this preliminary enlargement has not been noted. However, it may not occur in all cases.

In the early stages of the illness there is no pain or tenderness over the region of the liver, later both pain and tenderness may become marked. The pain may be paroxysmal in character.

Ascites may be present in some cases.

The bowels are constipated and the stools usually clay coloured; towards the end, however, there may be incontinence of faeces. In one case recorded " the motions contained plenty of bile-pigments. " (Ref vi)

The tongue is usually clean and moist in the early stages of the disease.

The Spleen is normal in size but may increase somewhat when the liver takes on its preliminary enlargement.

The circulatory System.

The heart sounds are normal and there is no enlargement of this organ.

The pulse is of low tension and the rate is diminished in frequency. It may occasionally be intermittent, especially towards the end, also a few days before death the pulse rate may increase.

The blood does not show anything of note. The R.B.C. count is usually normal, 4,000,000 to 5,000,000 per c.mm. and the Haemoglobin 60 to 90 per cent.

In the case mentioned previously " the R.B.C. showed an abnormal resistance to solutions of sodium chloride, unlike the abnormal fragility in many cases of haemolytic jaundice.

(Ref. i.) At a meeting of the Royal Society of Medicine on January 23rd, 1917, Capt. Stewart R.A.M.C. described the blood changes in fourteen cases of toxic jaundice from T.N.T. which came under his observation.

(A) " The chief changes were in the leucocytes.

(a) Neutrophile Leucopenia. This the most striking of the leucocyte changes was present at some stage of the disease in 9 out of 14 cases which were examined. In

some cases the leucopenia was extreme, and in others it was progressive and terminal. One case illustrated very well the polymorphonuclear recovery which accompanied clinical improvement in the condition of the patient.

(b) Neutrophile-Leucocytosis was present in a notable degree in one (fatal) case only.

(c) Lymphocytosis was another commonly observed change, it occurred at some time or another in 9 out of the 14 cases and varies in different patients.

(B) Changes in the Erythrocytes and Haemoglobin

These were much less conspicuous than the leucocyte changes. A serious degree of anaemia was observed in three cases only, in all the others, including two of the fatal cases, the red cell counts were over 4,000,000, but a slight grade of chlorotic anaemia was present in several.

In the three serious cases the anaemia was of the pernicious type "

At the same meeting Dr. P.N. Panten said that of " 19 patients suffering from poisoning by T.N.T., 15 of whom had toxic jaundice, nothing abnormal was found in the blood in 13. "

Deep cyanosis occurs towards the end.

The Respiratory System. No abnormal signs or symptoms are observed in the lungs, but the rate of the respirations is increased towards the end.

Bronchitis, pneumonia or tubercle may be one of the terminal phenomena.

Nasal catarrh is sometimes present.

The Nervous System.

Headache is a common symptom and has occurred in one fatal case as early as a fortnight from the commencement of work on Amatol(this contains 40% of T.N.T.)

There is usually a feeling of dullness and languor, and as the patient becomes more jaundiced he becomes more drowsy.

Irritability, depression and restlessness manifest themselves at intervals. Delirium and at times maniacal attacks may show themselves even quite a considerable time before the end, and the patient may be very violent at these times.

There may be retention of urine, and the catheter may be required.

Cerebral symptoms and transitory unconsciousness may at times appear, and in the intervals the patient may be quite rational. Also at times there may be convulsive attacks with retraction of the head and a peculiar cry.

There may be spasmodic movements and tremors of the hands and arms, and no sensation in some parts.

Later there is incontinence of urine.

The pupils are sluggish and react slowly to light. The reflexes (knee-jerks, plantar and abdominal) show no change and there are no signs of organic disease of the nervous system.

There are no pains in arms or legs.

The Urinary System

The urine is dark coloured and in some cases may be almost black with pigments.,

It is usually faintly alkaline in reaction, and its sp. gr. is practically normal, unless when sugar is present.

Phosphates are sometimes present. There is usually no albumen but occasionally albuminuria is present. Bile pigments and bile-salts (glychocolate and taurochocolate of soda) are ~~present~~ both found. The amount of the bile in the urine varies during the course of the illness and towards the end it may practically disappear.

Sugar in the form of a glucose is sometimes present, and may be intermittent in its appearance.

In case No. 9 it was absent for two or three days at a time. The cause of this I was unable to determine, as it has no relation to his food. The percentage of sugar was high on some days, amounting to 4.5% on one occasion.

I should think that the presence of sugar is the exception rather than the rule in these cases.

There is no acetone or diacetic acid.

In the case under my own observation I was unable to detect any leucine and tyrosin crystals, but I believe in some cases of toxic jaundice both leucine and tyrosin have been found.

No blood is present, as a rule.

As mentioned before, as the disease advances there may be retention of urine and towards the end there is incontinence.

General Symptoms.

Pruritus does not give any trouble although in some cases the jaundice is quite marked. As far as I can learn cutaneous manifestations such as boils, urticaria, lichen, etc. (which are common ⁱⁿ ~~and~~ protracted obstructive jaundice) have not been observed in toxic jaundice due to T.N.T.

The temperature is usually subnormal during the course of the disease.

Purpuric spots have been observed on the skin in some cases.

It is interesting that this type of jaundice bears a close resemblance to that caused by tetrachlorethane described by Dr. W. H. ~~WILLCOX~~ Willcox. (Ref ii)

(c) ANAEMIC TYPE.

This type of the disease is extremely insidious. Fortunately it is very rare, as very few cases have been observed.

The early symptoms are anaemia, shortness of breath, abdominal pain, lassitude, giddiness, extreme pallor, nausea, vomiting and sometimes constipation.

Probably the most striking feature of the case is the extreme pallor of the skin and mucous membranes. The skin is somewhat of a pearly whiteness and not quite the lemon-yellow tint which is observed in pernicious anaemia. The conjunctivae are also extremely pale.

The Alimentary System.

The tongue is very pale and is clean at first but later it may be furred. Ulcers and soreness of the mouth and tongue were not observed, but one of the cases had marked pyorrhoea.

Pain in the stomach was present in both cases. Nausea and vomiting may appear early and they always appear at some stage of the illness.

The liver and spleen do not show any enlargement, and there is no tenderness in the abdomen.

Diarrhoea was not observed in either of the two cases, on the other hand one of the patients suffered from constipation. The appetite is sometimes unimpaired

The Circulatory System.

The heart is dilated to a varying extent. No murmurs may be heard at first except the "bruit de diable" but later a haemic murmur soft blowing and systolic may be detected in the mitral area.

Palpitation is frequent and syncopal attacks sometimes occur.

The pulse as a rule is rapid, but it is easily affected by excitement or movement.

Dyspnoea is often a prominent symptom as is to be expected when the heart is enfeebled and the amount of haemoglobin in the blood is so small. Towards the end the air hunger may be extreme.

Haemorrhages of various kinds may take place, they come from the mucous membranes such as bleeding and oozing from the gums and also from the nose.

I have not observed retinal haemorrhage during life, but after death signs of haemorrhages were discovered in the central nervous system^{and} also in the skin. One of the cases had haemorrhage into the conjunctiva and iris of the left eye a few days before death

The Blood.

The total quantity of blood in the body is much diminished, so much so that it is often difficult to get a sufficient quantity for examination. The blood is pale and watery, and abnormally fluid.

The red corpuscle count varies very much, but it is always much less than normal and varies from about

1,000,000 to 1,500,000 per c.mm.

The colour indices in the two cases recorded were different, being higher than unity in one case and lower in the other.

Stained films of the blood were almost normal in appearance except for the scantiness of the R.B.C. and the relative absence of leucocytes. As a rule, however, several larger and several smaller varieties of red cells could be observed, and occasionally poikilocytes. On none of the many occasions on which one examined blood films were nucleated red cells to be seen. I think this is a very important point especially for differential diagnosis as I shall mention later.

The white corpuscles are very much diminished in numbers, there being a total decrease of the leucocytes. This total decrease of the leucocytes is made up of a relative decrease of polynuclears and a relative increase of both large and small lymphocytes.

There was no bile in the blood serum of these two cases.

The Respiratory System.

There is nothing characteristic in the lungs during the early stages of the disease, but as the case progresses a cough which may be troublesome develops. The cough is probably due to the oedematous condition of the lungs and bronchi. Later the breathing may be embarrassed, and laboured.

The Nervous System.

The chief symptom here is headache which is fairly constant and may be slight or severe. Headache on waking in the morning was a constant feature in one of the cases.

Vertigo and a thumping sensation in the head are frequent and there is also occasionally a mist before the eyes.

There was no loss of knee jerks or disturbances of sensation.

The temperament of the two cases recorded was very hopeful, both of them were very cheerful, one of them especially, he was always "much better" when spoken to. There was no irritability of temper, which is sometimes seen in other severe anaemias, and only occasionally was there depression. As the disease progresses the patient becomes more and more lethargic, and restlessness and delirium precede the end.

The Urinary System.

The urine presents no abnormality, and is usually pale. In one case there was ^aslight trace of bile at the commencement. There is never any blood, albumen or sugar.

General Symptoms.

The temperature follows no general course during the disease. It may be normal or subnormal, but occasionally one finds pyrexial attacks which have little relation to the severity of the case.

The cause of the fever is unknown; it may be due to ~~the~~ capillary haemorrhages in the heat regulating

centres (numerous small haemorrhages were discovered in the central nervous system after death) or it may be due to increased blood destruction, and the inability of the already overcrowded liver to deal with the toxins.

In one case it may have been due to pyorrhoea alveolaris which was very marked.

The fever is seldom high (in one case it reached 101° only once.)..

II. LOCAL.

Dermatitis.

A fair proportion of the workers suffer from dermatitis in a varying degree of severity. It is really a dermatocniosis and consists in its milder forms of an irritation and roughening of the exposed skin.

The rash is an erythema and consists of patchy slightly raised irregular areas. The exposed skin nearest the work was in practically all cases the earliest seat of the ~~lesion~~ lesion.

It appears as a rule first at the back of the wrists, hands and fingers and also between the fingers. Usually before any rash is visible the worker feels a burning, tingling or itching of the skin.

The face - especially around the eyes - and the neck, particularly behind the ears, are also affected.

The arms often become affected and they sometimes present a continuous sheet of redness of a papular type from the wrists to above the elbows. Vesicles may appear which later become ruptured, so establishing a condition of acute eczema.

The inside of the thighs and scrotum and the lower part of the abdomen are often affected in those workers who are careless in washing their hands before going to the W.C.

Rashes also appear on the legs and feet and between the toes; these rashes are probably due to the powder getting in beneath the clothing.

Fine desquamation follows the rash, and the character of this desquamation depends upon the severity of the inflammation and the thickness of the epidermis.

Crusting may occur but only rarely have I seen the skin exfoliated in large flakes from the hands and feet.

Friction with dust-infected clothes, especially in hot weather, with excessive sweating increases the prevalence and severity of the rash.

As an example of friction with dust-infected clothes we may quote case No. 27. Here a man worked only one day in contact with T. N. T. (dry powder), on the next day a line of little papules appeared, encircling his neck following the edge of his collar.

Swelling of feet and hands may be observed sometimes as a sequel to the rash on these parts.

I have never observed the rash to affect the heads of workers on T. N. T.

The rash may be intensely itchy and burning, and so may prevent sleep. As a rule when a worker suffers from dermatitis due to T.N.T. he has no other, ~~or~~ very few, constitutional symptoms. It is very rare to find dermatitis and gastric conditions occurring together. The character of the rash is frequently altered by a secondary infection through scratching, so that a pustular eczema is produced.

In the cyanotic type of the disease the prognosis is good.

Practically all the cases recover their normal health under treatment, and complete removal from the influence of the poison. No injurious after-effects have been noted.

In the Icteric type the duration and type of the disease depend upon the extent and the rapidity of progress of the necrosis of the liver cells, and as it is so difficult to say clinically how far the disease has progressed it is best to be guarded in one's prognosis.

In cases of deep jaundice the prognosis is bad and recovery is unlikely; some cases undoubtedly recover and second attacks should never be allowed to happen, i.e. the person should be completely removed from T.N.T. When one sees the condition of the liver at a P.M. it is surprising that the patient should live so long.

The interval between disablement and death in the fatal cases of toxic jaundice varies very much, from 8 days in two cases to 79 days in one. The average duration is about 22 days. In case No. 9 it was almost two months.

In the Anaemic Type.

In a true case of aplastic anaemia due to T.N.T. the prognosis is decidedly bad. In the two cases, Nos. 35 and 45 that came under my observation no evidence of attempt ~~but~~ recovery was observed throughout the course of the illness, and both died in about two months from the time that I saw them first.

39. THE DIAGNOSIS & DIFFERENTIAL DIAGNOSIS.

It is most important that a correct diagnosis should be formed in these cases, not only from the point of view of the correct treatment for the patient and possible removal from further contact, but also the Workmen's Compensation Act is an added reason for correct diagnosis. Therefore it is most important to make quite sure that the patient has been engaged in contact with T.N.T. before making a diagnosis of " T.N.T. poisoning". This has been forced on my mind by seeing the large number of medical certificates saying that " --- --- is suffering from T.N.T. poisoning " when the said patient has not been on or near T.N.T.

In the Cyanotic Type.

The yellow staining on the hands is no sure guide that the patient is in contact with T.N.T. Yellow staining of the hands is met with in workers in contact with other explosives, e.g. C.E. (tetryl or tetranitromethylanilin) and in lyddite (picric acid or trinitrophenol) These explosives cause a dermatitis - which I shall discuss later - but their constitutional effects, in my opinion, are practically nil.

Given a history of contact with T.N.T. in a patient complaining of pains in the stomach and whose face has a dull expressionless look with ashen blue lips and constipation then one is quite justified in saying that the patient is suffering from the effects of T.N.T. absorption.

The differential diagnosis here will be between other conditions which set up gastric disturbances.

40. The Diagnosis & Differential Diagnosis.

Frequently workers on T.N.T. will come up complaining of various ailments which are obviously due to indiscretions in diet, bad teeth, debility, etc. In fact almost any disease from which the workers suffer is put down as being due to T.N.T.

One has always to be on one's guard in diagnosing these cases, as sometimes obscure cases of well known diseases are apt to be confused with T.N.T. poisoning, especially when the patient is taken ill at work. For example I have seen an early case of pneumonia with few definite symptoms being confused with T.N.T. poisoning.

The question of malingering also comes in here, some of the workers who desire a change of employment (from various causes, e.g. fear, more profitable employment elsewhere, etc.) may simulate T.N.T. sickness. Here one never sees any of the well known signs of the disease. I have known workers come up complaining of being poisoned, saying that they were vomiting, etc., yet when admitted into hospital and kept under observation they behaved as normal individuals.

The Icteric Type.

In these cases also the yellow staining of the hands and face may simulate jaundice, and therefore it is most important to look for the other well known signs before diagnosing toxic jaundice.

The diagnosis here is particularly difficult owing to the insidious onset of the disease. One is very apt to confuse it with an ordinary simple jaundice, such as catarrhal jaundice, and it is extremely difficult to

41. The Diagnosis & Differential Diagnosis.

differentiate.

However, with a history of working on T.N.T. one should always consider that the jaundice is of the toxic variety until the opposite is proven.

In Catarrhal Jaundice one cannot tell much by the onset of the jaundice as it is usually sudden in both. The jaundice is usually less intense in catarrhal jaundice and it generally subsides in 3 or 4 weeks.

There is a feeling of uneasiness and weight in the hepatic region in catarrhal jaundice which is not marked in T.N.T. jaundice.

In T.N.T. jaundice the temperature is normal or subnormal at the commencement of the disease, whereas in catarrhal jaundice there is often slight fever at the beginning of the attack. But as I observed before the differential diagnosis here may be difficult, and in some instances time alone can determine the true nature of the case.

In acute congestion of the liver the onset is sudden but here the jaundice is slight and the faeces are dark in colour.

In acute yellow atrophy there are premonitory symptoms with slight increasing tenderness over the liver, and usually severe symptoms (headache, delirium, etc.) set in in a few days.

Moreover the long duration of the acute stage with marked jaundice in T.N.T. poisoning helps to distinguish the case from that of one due to acute yellow atrophy.

In Epidemic Jaundice (Weil's disease).

The onset is sudden, but there is marked prostration

42. The Diagnosis & Differential Diagnosis.

and pyrexia which are absent in T.N.T. jaundice.

Other causes - some of which I have discussed - of toxæmic jaundice are grouped by Hunter as follows: *Ref iii*

1. Jaundice produced by the action of poisons, such as toluylenediamin, phosphorous, arsenic, snake-venom.

2. Jaundice met with in various specific fevers and conditions such as yellow fever, malaria, (remittent and intermittent), pyæmia, relapsing fever, typhus, enteric fever, scarlatina.

3. Jaundice met with in various conditions of unknown but more or less obscure infective nature, and variously designated as epidemic, infectious, febrile, malignant jaundice, icterus gravis, Weil's disease, acute yellow atrophy.

The Anaemic Type.

Extreme anaemia with shortness of breath and great pallor in a person who is not emaciated and who is employed in contact with T.N.T. should suggest aplastic anaemia.

The disease most likely to be confused with it is pernicious anaemia.

It has many points in common with Pernicious or Idiopathic anaemia. In both diseases the symptoms are very much alike; there is the increasing anaemia, lassitude, weakness, dyspnoea palpitation.

In the alimentary system there is the same type of pain in the stomach with nausea and vomiting.

43. The Diagnosis & Differential Diagnosis.

The circulatory system has also symptoms and signs much the same.. It is only when one comes to examine the blood that one can make a differential diagnosis.

I am speaking now from my experience of aplastic anaemia due to contact with T.N.T.. It is often difficult to diagnose with certainty a case of aplastic anaemia, and one has frequently to wait for the P.M. to establish a definite diagnosis.

The blood of the two cases hereafter referred to was characteristic. (Ref^{iv}) Gulland and Goodall say in their article on aplastic anaemia that "the colour index is generally low, but in a few cases it has been over 1. This is doubtless due to a certain amount of megaloblastic regeneration in parts of the marrow, so that megalocytes are turned out into the circulation. Too much stress, however, must not be laid upon observations on the percentage of haemoglobin, as it is very difficult to make accurate estimations when anaemia is extreme".

The diagnosis in the two cases recorded was made by the appearance of the red blood corpuscles.

The blood was frequently examined in film and it always showed microcytes and megalocytes in addition to normal size red corpuscles.

There were also a few poikilocytes, but never at any time during life did I observe a single nucleated red cell.

This blood therefore differed essentially from that of pernicious anaemia, where, as Osler says, "Nucleated red blood-corpuscles are constantly present" (Ref^v)

The leucocytes in these cases were diminished in numbers as in the case of pernicious anaemia. In these

44. The Diagnosis & Differential Diagnosis.

cases the reduction was greatest in the polymorph variety with a relative increase of the lymphocytes both large and small.

This form of anaemia from T.N.T., apart from the blood examination, can easily be diagnosed from other conditions causing anaemia.

Chlorosis is usually found in younger persons, and this disease rapidly improves under treatment by iron. It is, as a rule, a disease of women, whereas as far as my experience goes aplastic anaemia due to T.N.T. is found mostly in men. Also the characters of the blood are quite different.

In anaemia after haemorrhage, either acute or chronic, the blood has the characteristics of that of chlorosis and the red blood count is never so low as that of aplastic anaemia. In this type of anaemia the total number of the leucocytes is increased, whereas in aplastic anaemia the number is diminished. Then there is the history of the case as a guide.

A carefully taken history and thorough examination can, as a rule, exclude anaemias from such causes as, malaria, acute endocarditis, sepsis, gastric and intestinal cancer, syphilis, typhoid fever, lead poisoning, intestinal parasites and tuberculosis.

Some valvular affection of the heart might be suggested by the palpitation and shortness of breath.

The oedema of the feet and general pallor might cause the case to be mistaken for Bright's disease.

45. The Diagnosis & Differential Diagnosis.

Dermatitis.

Workmen come up with a great variety of skin affections which they claim as being caused by contact with T.N.T. For example men suffering from impetigo, acne, herpes, urticaria, boils, scabies, pediculi, etc. come up for T.N.T. treatment. As a rule these cases present no difficulty in diagnosis. There is a difficulty though when there is T.N.T. dermatitis in addition to any of the above. This also increases the difficulty of the treatment.

For outside practitioners the difficulty lies in the differential diagnosis from dermatitis caused by contact with other explosives.

As I mentioned before Picric Acid and Tetryl stain the hands yellow and their forms of dermatitis might easily be mistaken for that due to T.N.T. contact.

Picric Acid (lyddite or trinitrophenol) stains the exposed skin a canary yellow or greenish yellow colour. The hair is also stained, as a rule, a greenish yellow colour. The rash is somewhat like that due to T.N.T. but it chiefly affects the arms and forearms. My experience of Picric Acid is that it is not so liable to cause a rash as T.N.T. and not many workers complain of the rash which yields readily to treatment.

Tetryl (C.E. or tetranitromethylaniline) also stains the exposed skin a yellow or apricot colour. Almost every worker on this explosive at some time or another is affected with the characteristic tetryl rash.

It differs from the T.N.T. rash in that it chiefly affects the face. It is often quite severe, causing oedema

46. The Diagnosis & Differential Diagnosis.

of the face and almost closes the eyes.

Conjunctivitis is another characteristic of contact with tetryl and may occur with or without the dermatitis.

Fulminate of Mercury is another explosive that causes a rash. This rash appears chiefly on the face, but often the hands are affected in addition.

The rash is more blotchy than the T.N.T. rash, and it is frequently pustular. In addition there is usually a very severe conjunctivitis which is quite characteristic of fulminate of mercury contact. With ~~some~~ experience one can differentiate these different rashes with ease, and now I can quite readily tell by simply observing the dermatitis of a worker whether he is employed on T.N.T., Tetryl, or Fulminate of Mercury.

PROPHYLAXIS.

This is of enormous importance as in most of the cases with proper precautions T.N.T. sickness should be practically eliminated. This question has also a bearing on the amount of output as it is impossible to get the largest amount of work from a factory if a number of the employees are constantly on the sick list.

Then the question of the employ~~ees~~ themselves must be considered; in one factory alone 35% of the workers were off many days through minor T.N.T. illness. Consequently there is a great loss of money amounting to many pounds a week in some factories.

A number of deaths have been reported from time to time due directly to T.N.T. poisoning.

It was stated in the House of Commons on October 25th. 1916 " that the number of reported cases of tri-nitro-toluol

poisoning for the nine months ending September, 1916, was 95, and the number of deaths 28."

These cases all refer to toxic jaundice and show a very high percentage of deaths. Fortunately the death rate compared with the number of workers employed on filling shells with T.N.T. is small.

The incidence of minor T.N.T. sickness is much greater and with proper precautions the death rate and sickness incidence should be very much reduced.

Before the war there were a number of workers engaged on filling T.N.T., and as far as it is known there were no injurious effects. This was often quoted as an argument that work on T.N.T. was not injurious to health. I have had men shown me who have worked for years on T.N.T. without any injurious effects, but this proves nothing more than that these men had superior vitality, and that probably many of their fellow workers had vanished altogether. One is also apt to forget that these men worked under pre-war conditions in which ^{were} there not so many adverse conditions as exist to-day.

I shall discuss some of these conditions and also try to make some suggestions as to what should be avoided. Many of these suggestions may seem to be of very little use, and some of the authorities of factories may think that these prophylactic measures interfere with the output. They forget that the health of the workmen is of paramount importance, and as the health of the workmen is kept at a high standard ~~so~~ ^{so} ~~pari passu~~ the output is high.

One of the conditions that I noticed was the fact that most of the workers lived a long distance from the factory; this, unfortunately, was unavoidable. Owing to the large number of people employed it was impossible to get suitable accommodation for ^{all of} them near their work. In many cases the workers spent four hours each day travelling to and from their work.

Then the shifts were always 12 hours long, and taking into consideration the time spent on travel there was very little time for rest and relaxation. In many cases the workers were unable to get a sufficient amount of sleep, thus the amount of fatigue produced was very great, and this fatigue was different from that produced for example by the farm labourer in the open air. It was produced in the close air of a factory often overheated and imperfectly ventilated.

With such a short time for rest there was never sufficient time for the fatigue products of the day's work to be got rid of, and next day the fatigued muscles had again to work under the same adverse conditions. Also under war conditions the workers were employed seven days in the week, which made it even more difficult for them to get thoroughly rested and refreshed.

Several prophylactic measures are recommended:

1. No person under the age of 21 and over 40 should be employed in filling T.N.T. and only those in good health.

At the present time it is very difficult to carry out this suggestion. All men who come under this category

and are eligible for T.N.T. work are in the army. We have to draw for our workers on men ~~man~~ in B and C Classes and invalided or wounded soldiers. However, with careful examination and discrimination one is able to get a fair number of workers.

Women who are anaemic or otherwise ill should not be employed. At the beginning of the war boys were employed here on T.N. T. but this has been discontinued with good results. The fatality under 18 years is striking, out of 9 reported attacks of toxic jaundice there were 6 deaths, as statistics from the various factories show.

2. A routine examination should be made by a medical officer each week, both for night and day shifts. By examination is meant that the Medical Officer sees the employe^es whilst they are actually at work; it is not sufficient that one should wait, say at an office, and see any worker who complains or who feels unwell. If an actual inspection is not made whilst at work, one is apt to miss the worker who does not want to make a complaint, and also by going into the workshops one is able to detect the early cases before the disease has made any serious inroad.

At this inspection any worker who shows signs of over-fatigue, anaemia or excessive cyanosis should be removed from contact for a time.

3. Special clothing should be provided, including overalls, caps, gloves, veils and respirators. The overalls and caps should be clean and in sufficient numbers. The overall should fit completely round the neck and cover the whole person of the worker. The sleeves of the overall should on no account be rolled up whilst at work.

Gauntletted gloves without holes in them should be provided for all persons employed. The cuff of the glove should be inside, underneath the sleeve of the overall, and this should be fastened securely at the wrist.

Careful supervision is required when gloves are worn, as workers are often careless and T.N.T. may get inside, under these circumstances the wearing of gloves is worse than useless.

Veils and respirators are also useful but the majority of workers find them uncomfortable. The veils should be stamped to distinguish surfaces in use.

Respirators can be made easily out of gamgee tissue and should be renewed at intervals.

4. Employment involving work on T.N.T. should as far as possible be alternated with other work.

The workers here are employed for three weeks at a time on T.N.T. and then at some other work for 3 weeks where they do not come in contact.

This is of great importance as it allows the body to eliminate any of the T. N. T. which has been absorbed whilst at work. The body is thus able to deal with small amounts of poison, whereas if the quantity of poison absorbed becomes greater than the amount that can be dealt with, symptoms are almost certain to show themselves and these will be progressive unless the worker is removed from the toxic environment.

5. The total daily exposure to the toxin must not be too long. because, in order to reduce the poisoning it is necessary to reduce the amount of the dose.

The total daily exposure should not exceed 8 hours, but this unfortunately ~~cannot~~ is not always practicable.

Night work on T.N.T. should be lessened as much as possible.

6. Nutrition.

All persons before commencing work should be provided free with $\frac{1}{2}$ a pint of milk (hot if possible) or cocoa. The taking of this should be insisted upon.

Facilities should also be provided for obtaining suitable and sufficient food at proper intervals. One frequently meets with persons who for various reasons (such as getting up too late from bed, want of appetite, etc.) come to work without having a proper ~~breakfast~~ breakfast.

Canteens should provide at a moderate price ~~what~~ hot well-cooked meals with plenty of green vegetables, as this diet is specially suitable for T.N.T. workers.

Arrangements should be made to enable women to obtain hot drinks during the night.

Alcohol should be avoided, as excess will lower the resistance of the worker.

7. Cleanliness both personal and whilst at work is very essential. The personal cleanliness of the workers is most important and they should be impressed with the necessity of washing the hands and face before meals.

If the worker wears artificial teeth the denture should be carefully cleaned before a meal.

Washing at the end of a shift is also important.

The worker should be warned not to sleep in clothes worn during factory work, and the underclothing should be

changed frequently.

The use of baths should be encouraged. It is important that all trace of T.N.T. should be removed from the body, otherwise absorption from the skin will continue to take place during the intervals away from work.

Attention to cleanliness may make all the difference whether the work can be done with or without detriment to the health.

In addition to personal cleanliness another important consideration is carefulness and neatness in work. There must be cleanliness of the working place in addition to cleanliness of the person and the cloths. This may explain the reason why one worker is "susceptible" to the illness when another escapes. T.N.T. is so difficult to ~~make~~ explode that great carelessness with it prevails in some factories. It is sometimes allowed to accumulate around the outside of the shells, on the floor and in fact all over the place.

I have been informed that in one factory, where such a condition of affairs existed, there ~~were~~ a large number of cases of jaundice reported.

In my opinion many of these cases were preventable, because several of these cases occurred in persons not actually engaged in filling but on trucking, etc.

Cleanliness plays a large part in our immunity from serious cases here.

8. Spacious and well ventilated work-rooms help to reduce the ill consequences of work on T.N.T.

Proper ventilation should be insisted upon and some mechanical device of the " exhaust " fan type should be used to get rid of dust and fume.

9. Whenever possible the processes of

(a) Melting T. N. T. and

(b) Pouring it into shells and other projectiles should be carried on in different work places.

10. There should be provided

(a) a suitable cloak room for clothing put off during work hours.

(b) a suitable place, separate from the cloak room for the storage of overalls.

(c) suitable washing accomodation with

I a neutral soap and

II an ointment for application on leaving

work, e.g. castor oil 2 parts
lanoline 1 part.

11. Welfare Supervisors to gather up and co-ordinate various details which at present receive insufficient attention. The principal overlookers are mainly concerned with the question of output, and have not the time or the necessary knowledge to insist on all the various prophylactic measures.

The intelligent co-operation of the worker is also required in order to carry out those prophylactic measures (such as a proper amount of rest, suitable food, and attention to cleanliness) which directly affect himself or herself.

The evil effects of the work on T.N.T. cannot be overcome by the use of one precaution but only by the intelligent use of the combination of several precautions.

TREATMENT.

The first essential in the treatment of T.N.T. poisoning (of any type) is removal from contact either by alteration of employment, treatment at home or treatment at hospital.

The patient must be instructed to remove all rough excess of T.N.T. from the hands, from underneath the nails, at the roots of the hairs of the scalp and other parts of the body and to divest the body of all clothing that has been in contact with T.N.T.

If necessary the skin should be freely cleaned with a good solvent of T.N.T. such as acetone, benzene, ethyl acetate or amyl acetate.

At present acetone is being used with the patients here.

These solvents must not be allowed to dry on the skin but applied by saturated cotton wool used for sponging the skin and rejected while still moist.

(A) The Cyanotic Type.

In this type of case the workers invariably recover quickly under treatment without being removed from contact, but if the symptoms are severe or do not clear up under treatment then a change of work is ordered, e.g. 3 weeks at some other employment which does not entail

coming in contact with T.N.T.

A mixture of such as the following:

R.

Pulv. Rad. Gent	gr. 5
" " Rhei	gr. 5
Pulv. Zingib.	gr. 1
Pulv. Sod. Bic.	gr. 10
Ol. Menth. Pip.	m. $\frac{1}{4}$
Aq. ad.	oz. $\frac{1}{2}$

sig. oz $\frac{1}{2}$ t.d.s. ex. aq.

or Sod. Bicarb. alone is given, and a mixture of the latter kind is kept at the factory for the use of any of the workers who complain.

When constipation is present Mist. Alba is given to be taken in the morning before breakfast, and if necessary vegetable laxatives, ~~cascara~~ *sagrada*, calomel or colocynt. If the cases are more severe and not suitable for the above treatment they are put on the injury list and given medicine and allowed to go home. At the same time they are told to report every other day or so.

If it is considered that the patient's condition necessitates personal supervision then he is admitted to hospital and put to bed at once.

The patients, as a rule, recover rapidly under the following treatment.

Rest in bed for a few days. The room occupied by the patient should be well ventilated and ^{the} air kept pure and fresh.

Light Diet such as milk in all forms, e.g. milk puddings, ~~and~~ bread and milk and Benger's Food; green vegetables and sometimes potatoes, fish, uncooked fruit such as apples and oranges may be given. (Soups, meats, meat extracts and alcohol are avoided).

As Drinks the following are useful, orange, lemon or lime juice, imperial drink, barley water, rice water, whey, milk and soda, weak tea and coffee.

The following is given as a routine measure:

R.

Sod. sulphate	dr.	$\frac{1}{2}$
Pot. Citrate	gr.	40
Sod. bicarb.	gr.	20
Syrup. simp.	dr.	1
Aq. ad	oz.	1

Sig. T.D.S. 1 oz.

If diarrhea is present a mixture containing bismuth and soda is given e.g. R.

Bis. carb.	gr.	10
Sod. bicarb.	gr.	10
Aq. ad	oz.	$\frac{1}{2}$

T.D.S.

When abdominal pain is marked soda bicarb. is given alone and fomentation applied if necessary.

For the anaemia:

R.

Ferri et ammon. cit.	gr.	10
Spt. ammon. aromat.	m.	10
Aq. ad	oz.	$\frac{1}{2}$

T.D.S.

or

R.

Ferri sulph.	gr.	2
mag. sulph.	gr.	30
ac. sulph. del.	m.	5
aq. ad	oz.	$\frac{1}{2}$

T.D.S.

such symptoms as faintness, giddiness and nausea rapidly clear up with rest in bed and if necessary a mixture like the following is given:

R.

Sod. Bicarb.	gr.	10
Sp. amman. arom.	m.	10
Tinct. card. Co.	m.	10
Infus. Gent. Co. ad	oz.	$\frac{1}{2}$

T.D.S.

If the patient is very collapsed an initial injection of strychnine or ~~pituitrin~~ pituitrin may be necessary.

When the patient is considered fit for duty he is usually given exemption from work on T.N.T. for some weeks and in severe cases he is given permanent exemption from contact with T. N. T.

B. The Icteric Type.

Here the treatment is more difficult and the outlook is not so bright, as one is often dealing with a liver that is extensively diseased.

All icteric cases, even though apparently mild at first, should be admitted to hospital and treated by rest in bed.

The treatment aims at stimulating the liver functions and to try ^{to} ~~and~~ eliminate the toxins before they produce further degenerative effects.

As a rule it is a question of treating symptoms as they ^{arise} ~~arise~~.

An initial dose of calomel or blue pill (3 or 4 grains) may be given, followed by a saline. An initial dose only should be given, and this type of jaundice should not be treated by repeated small doses of calomel.

Want of appetite may be treated by ~~nausea~~ vomica and dilute acids.

For Nausea and vomiting bismuth and Hydrocyanic Acid Dil are useful.

As a rule itching of the skin does not give any trouble.

If there are haemorrhages calcium chloride 15-20 grains T.D.S. for two or three days at a time may be given. It should not be used longer than 2 or 3 days at a time as it loses its effect in promoting coagulation of the blood after a comparatively short time.

Linseed and mustard poultices to the liver may be tried.

Rectal and subcutaneous injections of saline are useful. One pint or two pints may be given subcutaneously each day or a rectal injection of sodium bicarb. 3 dr. and normal saline one pint may be given every 8 hours.

Infusion of normal saline one pint or two pints may be given each day instead of the above.

The injections of normal salines should be continued until the toxic symptoms improve.

Alkali-producing drugs, such as citrates and bicarbonates should be given to counteract the tendency to acid intoxication.

The other symptoms are treated on general lines.

C. The Anaemic Type.

As in the former type the treatment is again difficult. In this case difficult because one has to deal with an exhausted marrow.

In this as in the other severe anaemias the first essential is perfect rest in bed. The patient must rest both physically and mentally as much as possible. He should have plenty of fresh air and cheerful surroundings.

The feeding may be a difficulty owing to the condition of the alimentary canal. He should have as much good food as he can take

Milk and farinaceous foods are probably best as it is often difficult for the patient to take meat. All food of an indigestible nature should be avoided.

It is of the utmost importance that there should be neither constipation nor diarrhea, and the mouth and teeth should be carefully looked after.

Gastric lavage and irrigations of the intestines would probably give good results.

Injections of blood serum and defibrinated blood may be tried, as direct transfusion of blood is not always attended with good results, haemoglobinuria resulting owing to the breaking down of the corpuscles which are injected.

The subcutaneous injection of normal saline might also be tried.

The only drug that is likely to be of any use is arsenic or one of its derivatives. Arsenic in the form of Fowler's solution is probably the best method. Beginning with small doses, m.3 or m.4 T.D.S., the dose may be gradually increased until the patient is taking m.15 to m.20 T.D.S.

Other forms of arsenic might be tried such as the sodium cacodylate, or atoxyl may be given hypodermically in gr. $\frac{1}{2}$ doses every five days.

The arsenic probably acts by stimulating regenerative changes in the bone marrow.

Iron might probably do good in some cases when given along with arsenic.

Intestinal Antiseptics such as Salol, B-Naphtol and salicylate of bismuth should be tried.

It would be interesting to watch the result of the internal administration of red bone marrow in these cases, as this might stimulate the marrow that the patient has left.

Salvarsan has been used with success in the treatment of pernicious anaemia by Dr. Byrom Bramwell, and it might give favourable results in these cases also.

Dermatitis.

If the dermatitis is slight the worker may continue in contact with T.N.T. and under treatment will recover. However, if the symptoms are severe it is much better that there should be complete removal from contact.

It is very important when a change is recommended to see that these cases are not transferred to a department where they are still in contact with irritants such as Turpentine, tetryl, fulminate of mercury, etc.

Any of these irritants will very much aggravate the dermatitis from which the worker is suffering.

If an improvement is not seen under treatment and removal from contact, then the worker should be put on the injury list and removed from work until cured.

I have found the following ointment exceedingly useful. In my experience it seems to do better with the early stages than anything else.

R.

Bismuth subnit	Dr. 2
Zinci oxidi.	dr. 2
Paraffin moll	oz. 1

Sig. The ointment.

The following lotion:

R.

Calamine	gr. 15
Zn. oxid ^s	gr. 15
Glycerin	m. 10
Liq. calcis	dr. 1
Aq. ad	oz. 1

has also given good results in many cases and I often use it alternately with the Ungt. Bis. et Zn.

In a few cases ungt. Resorcin Co. N.F. has proved useful.

Tragacanth and glycerine liniment may also be used.

An ointment composed of Ungt. zinci, lanoline, ol. ricini in equal parts may be tried.

Calomel used as a dusting powder has done good in a number of cases which seemed to resist other treatments.

At the present time all fresh cases of dermatitis are being rubbed over with cotton wool dipped in acetone before any other treatment is applied.

The idea is to dissolve out any of the T.N.T. that may remain in or on the skin and so remove any further cause of irritation. For so far the results have been very satisfactory and it is proposed to continue with this treatment.

Conjunctivitis, as a rule, gives very little trouble and most of the cases clear up rapidly with Lotio Boracic.

Nasal irritation is seldom met with. Liquid paraffin may be tried in these cases.

For the swelling of the feet and hands it is essential that the patient should be kept in bed, and the same may be said for the severe cases of dermatitis.

I have found Lotio Plumbi cum Opio useful in some of these cases. In other cases it has not proved useful.

If scabs or crusts form it may be necessary to use Starch poultices. I usually order Pulv. Boric dr. 1 to each poultice, and sometimes boric fomentations give good results in clearing up some of these cases.

From lack of treatment or imperfect treatment severe cases may develop into chronic eczema which often gives a great amount of trouble before finally clearing up.

During treatment the question of diet plays an important part, and I have seen a patient leave hospital practically all right and return in a day or so with the dermatitis again very acute owing to an indiscretion in diet on the previous night.

Severe cases, on leaving hospital, should be warned to avoid any irritants for some time such as the direct rays of the sun, cold winds, etc.

While the latter part of the thesis was being written I was under orders for France, as a consequence I was unable to revise and re-type it. I also regret that I have been compelled to leave out the histories of some cases.

F.O. Clarke.

63. HISTORIES OF CASES (ALL MALES)

Three of which (Nos. 9, 35 & 45) were fatal.

Case No. 1.

W.R. Aet. 39. In contact 5 months.

History taken 13.2.16.

When on day work he leaves his home at 6 a.m. to arrive at work 8 a.m. Started work on T.N.T. filling shells. 3 Days every fortnight has been working on the coppers, melting T.N.T., the rest of the time filling shells. After working 5-6 weeks he complained of pains in the stomach. Immediately afterwards he was laid up and was off work for 10 days with Influenza. The pains disappeared and he went back to work.

On 10th Feby., 1916, he has pains in stomach again just " as if there was a lump lying in the stomach " about 2 inches above umbilicus; he had also pains and soreness across the chest. He vomited once that night and since then has felt easier.

He had worked constantly for 5 months on T.N.T. 11th Feby, 1916, he came to the surgery at night, and was recommended for a change of employment for a month from T.N.T. and prescribed for.

12th Feby. 1916, morning. He returned to the surgery and was admitted to hospital; he was then complaining of stomach and chest and severe headache all around the head.

Present condition: cyanosis slight, somewhat anaemic, slight icteric tinge in conjunctivae; no alb. , no blood no bile in urine. Motions normal.

Pulse good but slow, 50. Knee jerks, normal. No rash on skin. He is not constipated and has no difficulty with bowels. Put on milk diet and is much easier but still complains of slight pains in stomach.

Admitted to hospital 12.2.16; discharged from hospital 16.2.16 much better but still very anaemic and feeling slight pains in stomach.

19.2.16. Anaemia less but still feels weak. Pulse 80. has still pains in stomach.

22.2.16 Still complains of slight pains in stomach. Anaemia less. Allowed to resume duty.

24.2.16 Has not complained of anything since.

Case 2. P.R. Aet. 42. Complexion, Fresh. Teeth, fairly good.

In contact for 4 months. Came to surgery first time on 14.2.16. Ten days ago complained of pains in stomach and sickness, especially when ~~arriving~~^{going} home in the evening. He says he noticed pains in stomach more when working on American Trotyl as it is more dusty. Bowels regular, not constipated. First visit to surgery 14.2.16, said "he felt weak" through sickness", does not feel "as brisk as usual" and on 11.2.16 he felt in a state of collapse. He had a "raw feeling" in centre of chest. He was treated with Ungt. Hyd. Ammon. for upper lip and given Mist. Ferri et Ammon. cit.

Marked cyanosis; ~~is~~ is anaemic. No jaundice. No alb., no sugar, no bile in urine.

Pulse good, 100. Knee jerks, normal. Slightxx rash on upper lip.

18.2.16 Still, anaemic and cyanosed. Pulse 80
21.2.16 ditto ditto Pulse 84.

Allowed to resume duty 23.2.16, but to be removed from T.N.T. for four weeks.

Case 3.

H.Y. Aet. 55. Complexion, Fresh, Teeth, good.

2 weeks in Contact.

14.2.16. Lives $\frac{3}{4}$ hour from his work. Started work here on Oct. 1915, trucking in another department for 3 months. 14 days ago started to fill war heads of torpedoes. Two days later noticed little blisters on his fingers. Treated for these at surgery by M.O. The rash has been spreading and is now - 14.2.16 - on hands and forearms almost to elbows; also on face and slightly on legs.

No cyanosis, no anaemia, no jaundice. Pulse, good, 72.

Knee jerks, normal.

Treated and recommended to be removed from T.N.T. for 4 weeks.

16.2.16. Rash less and says irritation not so acute; swelling less after treatment with Ungt. Bismuth and Zinc.

19.2.16 Rash on hands, wrists and arms very much better; swelling practically gone from arms.

Case 4.

W.B. Aet 14. Complexion, fresh, Teeth, good.

History 15.2.16. In contact, one month. Employed filling bags with T.N.T. powder. 1 hour's distance from work. Yesterday felt pain in stomach. No cyanosis, somewhat pale; no jaundice. Urine, normal. Pulse, good, 72. Knee jerks, normal. No rash. Bowels move only twice a week. To be removed permanently from T.N.T.

66. Histories of Cases.

Case 5.

C.B. Aet. 38. Complexion , Dark. Teeth, fair.

History 15.2.16 In contact, 4 months. Employed on dry T.N.T. in bags. About 12 days ago complained of rash on anterior aspect of wrists and between the fingers.

11.2.16 came to surgery for treatment of rash. No cyanosis, no anaemia, no jaundice. Urine, normal. Pulse, normal.

Knee jerks, normal. Does not complain of anything except rash. Treated with Ungt. B. et Z. and Mist. Ferri et Ammon. cit. and removed from contact with T.N.T. for a time.

15.2.16. The rash has much improved and is now almost better.

Case 6.

W.P. Aet. 29. Complexion, Pale. Teeth, fair.

History 16. 2. 16. In contact 2 months. Has been filling shells with Liquid T.N.T. since December, 1915. Every fortnight he works two nights on the coppers, melting T.N.T.

On 13.2.16 he felt a " grabbing pain " in right side. He did not vomit. The pain is over the appendicular arca and is not tender to touch. He is also very anaemic. He says that his appetite has not been good since he has been working on T.N.T. He is being treated with Ferri et Ammon. Cit.

Case 7.

A.R. Aet. 42.

History. 16.2.16. Has been working on dry T.N.T. since August 1915. A month ago he noticed a slight rash on right hand over first metacarpal. A month before this (i.e. 2 months ago) his eyes and face - around eyes - were affected but these got better under treatment.

The rash on his hands has been getting worse and is now

somewhat severe on back of hands and back of wrists and it appears to be spreading. A few days after noticing rash on hands, his face began to be affected again and also his neck. His face and neck have become no worse.

On 14.2.16 he was recommended for a change of work and also treated, but he is no better and is to-day put on the Injury List 16.2.16.

He is very anaemic and says that he is weaker since the rash has been getting worse.

Treated with Mist. Ferri et Ammon. cit. and Ungt. Bis. et Zn.

19.2.16. Still very anaemic; hands and wrists somewhat better. Still feels weak and now treated with Tinct. Nuc. Vom. m.X to each dose of mixture.

Urine: phosphates present. No alb., no sugar, suspicion of bile.

22.2.16 Still anaemic. Hands and wrists improving.

25.2.16 Still very anaemic. Hands and wrists very much better. Feels " quite strong " now.

28.2.16. Allowed to resume work. Recommended for a change from T.N.T. for four weeks.

13.3.16. Reported and is still off T.N.T. Feels quite well. Still a slight rash on fingers and wrists.

Anaemia very much less and colour good.

25.3.16. Feels quite well. No rash on fingers, wrist or face. Still somewhat anaemic. Recommended for a further two weeks removed from T.N.T. Mist. repeated.

10.4.16. Still feels quite well and marked fit to return to work on T.N.T.

17.4.16 Well marked rash on back of hands and wrists

especially at bases of thumbs. He says that he has been working on C.E., Amatol and Picric Acid.

	10th	11th	12th	13th	14th	15th
P. Acid	P. Acid	Amatol	C.E.	C.E.	C.E.	

rash appeared on 11th, and has been getting worse; skin peeling off. Removed from contact with T.N.T., C.E. and other irritants for four weeks.

Case 8.

W.C. Aet. 14 $\frac{3}{4}$ years. Complexion, Fair. Teeth, Good.

In contact since June, 1915.

History. 16.2.16. Has been working on dry T.N.T. since June or July, 1915. 3 months ago he began to have pains in stomach, which improved, but he has had pain on and off since. He is still constipated and is also very anaemic.

Treated with Ferri et Ammon. cit. and one dose of Ol. Ricini
Pulse, 72. Very anaemic, herpes right side of mouth.

Permanent removal from contact with T.N.T.

Case 9. Fatal Case.

S. E. Aet. 14. Complexion, fresh. Teeth, Good.

In contact 7 weeks.

This boy first came to see me on 7.2.16. His condition then was: slight cyanosis, slight anaemia, NO JAUNDICE
Pulse, normal. No rash.

He was complaining of pain in stomach for which he was treated and recommended to be permanently removed from contact with T.N.T. He was also told to report in a few days if not better.

He did not return until 16.2.16 when he was suffering from well marked JAUNDICE. He was then admitted to hospital. He has an hour's journey from his home to work. Takes his breakfast at 5.30 a.m. consisting of a cup of tea and two slices of bread and butter or bread and marmalade. He has no further food until 1 o'clock, when he partakes ~~of~~ of the usual canteen dinner provided at the Danger Buildings. Occasionally he had a cup of cocoa before commencing work.

He started work in January - about 7 weeks ago - filling small bags with T.N.T. powder. He kept quite well until about 3 weeks ago, when he began to have pain in stomach. The pain in stomach was slight at first but gradually increased in severity. It was not a continuous pain, but would disappear for a few hours and then return. It was so severe that when on night work he required to take a night off from work occasionally, and when on day work he would stay out for an afternoon.

He felt sick but did not actually vomit. Since starting work at this factory he has been constipated. Previous to this his bowels moved regularly each day. Now they move only once every two days. He has had headache a few times but no pains in chest or legs.

Family History: Father and mother both alive and well. 9 other children all alive and well. Father says that the boy was always in good health, and hardly missed a day from school. The boy held school championship for swimming.

Present Condition: Heart sounds, normal. No enlargement.

Lungs, no dulness. Breath sounds, normal

Liver, neither enlarged nor contracted.

Spleen. Not enlarged. No tenderness over abdomen.

Stomach, not enlarged, at examination it was very small as the boy had had no food for 4-5 hours previously.

Conjunctivae very yellow. Skin also was very yellow. He does not complain of any itching of the skin. He has some nasal catarrh. Knee jerks, normal.

Urine, no alb. no sugar, bile present.

Treated by rest in bed, light diet, Mist. Alba and Mist.

Ferri et Ammon. cit.

17.2.16 Boy is much better and pain is less. Jaundice, less.

18.2.16 Still feels better, has no pain. Jaundice much the same as when he came in.

19.2.16. No pain and jaundice less.

Urine, dark coloured, bile present, no alb. no sugar.

Faeces, part was clay coloured and part was normal.

24.2.16. Felt nauseated just as he was going to sleep.

25.2.16 Vomited after tea.

26.2.16 Treated with R.

sod. sulphate	dr 1
pot. citrate	gr 40
sod. bicarb.	gr 20
syr. Aurant.	dr. 1
Aq. ad	oz. 1

Sig. oz. $\frac{1}{4}$

T.D.S.

Mist. Ferri, etc. stopped.

27.2.16. Pulse, 64. Temperature 97.8.

Jaundice still intense, abdomen swollen and tense and distended with well marked veins, particularly below umbilicus. Liver, much enlarged and is $2\frac{1}{4}$ inches below costal margin in mid-clavicular line.

Spleen slightly enlarged.

No headache, no nausea, no vomiting, no pain, tongue moist.

28.2.16 Jaundice more intense than on 27.2.16. Abdomen not so distended. Had a good action of bowels ^{just} before examination. Stools, well formed (looked constipated) of a slate colour, not a clay colour. Liver and spleen as on the 27.2.16.

29.2.16. Liver increased in size $\frac{3}{4}$ inch since the 27th. ~~He is~~ He is still very jaundiced but asked to be allowed out of bed. Vomited twice, ~~and~~ bilious vomit.

3.3.16. Urine, alkaline in reaction, phosphates present. No alb.. Bile pigment present, also bile salts - Glychocolate ^{and} Taurochocolate of soda.

Sugar present in large amount (No sugar present previously) tested quantitatively by Fehling's method and found to contain 2.1 % sugar.

4.3.16. Bowels are still very constipated. He has always been constipated since he came into hospital. Stools well formed and of a clay colour. Urine very dark. He has a craving for ~~form~~ things like fruit, marmalade, etc. He likes water and always has a glass standing beside his bed. He is sometimes very cheerful and at other times he is dull, and lies down in bed (in daytime) and goes to sleep. He is more jaundiced than ever to-day. At 5.30 p.m. he vomited a quantity (pts. $1\frac{1}{2}$) of semidigested food of a chocolate colour.

5.3.16 During the night he again vomited of a more solid consistence. Urine, still very dark and Bile present. no alb. no sugar. Urine was carefully tested several times and no reduction took place. Temperature 98.4. Pulse 72. At 5 P.M. bowels moved, motions of a constipated nature and well formed of a clay colour. Liver somewhat less in size.

6.3.16 Urine (of 5th) still very dark, bile present in quantity, no alb. no sugar. oz. 36 passed in 24 hours.

7.3.16. Very dull to-day. Urine of 6th very dark.

Bile present in quantity. No alb. Sugar present in quantity. oz. 42 of urine in 24 hours.

During the night the orderly reported that he was out of bed and tried to get into another boy's bed and that he used bad language. (Boy must have been delirious, as otherwise he is a good boy) He was also calling out in his sleep. He took breakfast (tea, bread and butter) at 7 A.M., and at 9 A.M. he received his medicine. He did not take any food until the evening at 5.30 P.M. Between 9 A.M. and 5.30 P.M. he was not quite rational. He was somnolent, peevish and lay curled up in bed. Bowels had not moved for two days, and it was impossible to give him enema as he resisted. From 7 A.M. to 8 P.M. he did not pass urine, catheter was used and 26 oz. urine drawn off. Total 36 oz. in 24 hours. Urine bile present, no alb. no sugar. After catheter was passed he was quiet until 11.30 P.M. when he again became noisy. He was so bad that he disturbed the other patients and was transferred to a special ward. He had in all about 6 hours sleep, and kept waking and screaming at intervals during the night.

8.3. 16 At 3 A.M. he became more rational and spoke to his father and mother. He also took some milk.

His nasal catarrh has continued more or less since he came in. To-day his expectoration was blood stained. He has been very noisy and restless all day, kicking and screaming even when not touched or spoken to. He has a peculiar cry (like a cerebral cry)

Histories of Cases.

His tongue to-day is coated white with a red tip, it was always clean until to-day. Liver is increasing in size. I saw him at mid-day crying out and putting his hands over the region of the liver and saying that "some one was ~~put~~ putting a needle into his chest" Bowels have not acted since the 5.3.16 Pulse 62 and temperature ~~22~~ 97.

01. Ricini dr. 6 at 11.30 A.M. At 6.30 P.M. bowels moved, large well formed clay coloured stools.

Had a very bad night 8-9th March. 2½ hours total sleep, waking up at intervals, screaming and very restless. He tried frequently to jump out of bed.

9.3.16. Between 6-7.30 A.M. he expectorated a little. Slight discharge from nose. Did not pass urine, bowels did not move. Pulse 72, weak, Respir. 16. Temp. 98 Very restless and noisy all day with short sleeps at intervals. Catheter passed at 11 A.M. and 18 oz. of urine drawn off. Urine sp.gr. 10.17, bile present in quantity, no alb. no sugar. Is still shouting and screaming at intervals and almost maniacal. To-night 7 P.M. temperature 97, pulse 60, respir. 16 When asleep respirations are good, quite full and regular. Pot. Brom. gr. X given.

10.3.16 Urine drawn off 10.30 A.M. 11oz obtained. No. alb., no sugar, bile increased. Sp. gr. 1020.

Egg, bread and butter for tea. Brom. mist. given at 11 A.M.

Rather a restless day, but not quite so violent.

At 10.30 P.M. 15 oz. urine drawn off, sp.gr. 1020, bile present, no alb., no sugar.

11.3.16 Slept from 11 p.m. last night to 2.45 this morning. Woke up very violent and restless, and gripped his throat saying that he wanted "to stangle himself" Brom. Mist. given at 3 a.m. slept again, talked during sleep and

perspired freely. 10 oz. urine drawn off at 10 a.m. Temperature this evening 97, pulse 76. Respir. 24. Liver is smaller and is apparently at lower costal margin. At 7 p.m. he vomited a quantity of undigested food. 8 senna pods given.

12.3.16 8 more senna pods given and is much less constipated since. Urine 1015, bile present, no alb. no sugar.

13.3.16 Urine 1020, no alb. no sugar, bile present.

14.3.16. Stools not so constipated and not so clay coloured.

Vomited at 4.20 p.m. Urine passed naturally, sp.gr. 1020 26 oz. in 24 hours. No alb., bile present, .92% sugar.

Sugar is a glucose (glucozone crst. obtained)

15.3.16 25 oz. urine in 24 hours

16.3.16 26 oz. " in 24 hours , no alb. no sugar, bile present.

17.3.16 10 a.m. grain 1/6th Emetine hydrochlor given.

Pulse 80, 25 oz. urine in 24 hours. Sp.gr. 1023, bile less, no alb. no sugar. Stool still constipated, not so clay coloured.

18.3.16 22 oz. urine passed in 24 hours. Sp. gr. 1030, bile less, no alb. no acetone or diacetic acid. High percentage of sugar 4.5%. Ammonia also high. Pulse 80, respir. 22, very much weaker and mind is not clear at times, not a meningitis but a mania.

19.3.16 Very restless and noisy most of last night and bromides given. Pulse 68 and intermittent. Urine sp.gr. 1025 no alb. no sugar, some bile.

20.3.16 Very weak, Tem. 97. Pulse 76, resp. 24. Pulse intermittent. Face and neck somewhat swollen. Urine 18 oz. with stool, the latter being hard and clay coloured. Urine no alb. , no sugar, bile present. In the afternoon he was quiet and drowsy.

21.3.16. Has had tremors for some days. Tem. 97.6. Pulse 68 resp. 24. Much same condition all day. Calomel gr. 1 at 6.30 p.m.

Has not passed urine since 11 A.M. lies curled up in bed. Constantly dribbling from the mouth. Colour much better to day.

22.3.16. During night passed urine in bed. At 8 a.m. passed 8 oz. urine, no alb., no sugar, some bile. Not noisy, speech insistent but mind seems clear. Pulse 120, not intermittent, has not vomited for at least 2 days.

23.3.16. Urine sp.gr. 1020, faintly acid, no alb., no sugar, no acetone or diacetic acid, ~~mannitol~~ 1.7% uræa and 0.13% ammonia. Urobilin and bile salts present.

25.3.16 Urine 1018, no alb. no sugar, a little bile. Bile is decreasing and jaundice not so marked. Very noisy and bromides given.

26.3.16. Urine 1018, no alb., little bile, sugar in abundance, stools better colour. Face more swollen.

27.3.16. Urine, acid. little bile, no alb., no sugar.

28.3.16 " " " " " " " "

Quiet on the whole with occasional noisy bouts. Very noisy at 11 p.m. 10 gra. bromide given.

29.3.16. Woke up at intervals during the night, but much ~~quieter~~ quieter in the morning, perspired freely during the night. Urine contains a little bile, little sugar, no alb. Temp. 97.4 Pulse 76. Resp. 22.

30.3.16. Urine 1018. No alb. slight bile, some sugar. Screaming and banging his head during the morning. He was quiet and sensible in the evening. Noisy at 11 P.M.

31. 3. 16. Very noisy at 2 A.M. quiet during the morning.

1.4.16. Very nervous when the guns were firing.

2.4.16 Spent a much quieter night, Urine 1010, no alb. practically no bile, no sugar. Has been quiet nearly all day, and was able to be put into the general ward.

3.4.16 Fairly quiet during the day, very troublesome towards evening. Seemed quite mad. His one idea being to kill himself. He was seen at 11.30 p.m. and transferred back to small ward, where no other patients were present. Took bromide gr. 10 and slept one hour. Passed urine in ~~the~~ bed and expectorated on bed and floor.

4.4.16. Fairly quiet all day with noisy intervals. During the evening, screaming and shouting, ~~and~~ expectorated around the bed. Passed faeces in bed. Bromide given at 10.15 p.m. but no effect. Later Veronal gr. 5 given by nasal tube as he refused to take it by mouth. Very noisy until 1 a.m. later was drowsy. Perspired freely. Temp. 97.4, Pulse 80, resp. 22.

5.4.16. During the early morning breathing was laboured and of a bronchial character, pulse weak, temp. subnormal. Very wheezy, unconscious since midday. Passed urine in bed. Spasmodic movements of left hand and arm, also apparently no sensation in right arm. Very drowsy and pulse poor. Rales heard in the chest. Catheter specimen of urine, had no alb. and little bile and practically no sugar. ~~M~~ Resp. 30, temp. 100 in the evening.

6.4.16 Unconscious all night. Started screaming at 6 A.M. was sensible for 20 mins. and recognised his parents. Quiet all the morning with spasmodic movements of left hand and arm. Temp. 97.4 in the morning. Bowels not moved and enema given resulting in a constipated stool. Evening tem. 100.8 and resp. 30.

7. 4. 16. Morning temperature 97.6, Evening temperature 100.4. Respiration 30.

Condition much worse and swallows with difficulty. Passed urine in bed. Jaundice is getting deeper.

8. 4. 16. Very much worse and is unconscious. Jaundice is intense. Temperature all day 100, Respiration 30, Pulse 106, poor and intermittent at times. Breathing much laboured; saline given at mid-day but little retained. No vomiting and jaundice intense.

Died at 3.15 in the afternoon.

The POST MORTEM APPEARANCES are on the next page.

History of Cases.
-----POST MORTEM APPEARANCES- T.N.T. Case.
.....PATIENT Male. Age 14.GENERAL APPEARANCES.

Body of boy of small stature: Emaciated.

Skin discoloured, yellow, of greenish yellow type.

Post Mortem staining marked on back
and round neck.

No Petechial Ecchymosis.

HEAD

On removing the skull cap the brain bulged out in its membranes which were tense. The veins over its surface were engorged: the Dura was yellow especially in patches. There was slight corresponding staining of the inner surface of the skull.

The dura mater was adherent over and round the region of the Falx Cerebri on all sides, also in patches over the middle third of the brain on both sides. The vessels over the whole brain were much engorged.

On removal of the brain, there was a small quantity of fluid in the skull cavity. The brain substance was slightly softened round the frontal lobes, and also at the base. The whole brain was congested, and the vessel engorged. There was no staining of the brain substance, and the grey and white matter appeared normal. The ventricle No. IV showed nothing special -

Weight of Brain - 48 oz.

BODY

On incising the chest and abdomen, the rib cartilages were seen to be stained yellow, the intercostal and abdominal muscles were deep red.

The liver was not visible below the Costal Margin.

THORAX

Pericardial Sac. On incising the pericardium, some bile stained fluid was seen - there were no adhesions between the heart and pericardium.

History of Cases.

Heart.

The heart was flabby, small and its surface slightly discoloured - otherwise nothing to note by naked eye.

Cut surface bulges slightly and is of a café au lait colour.

Heart - 6 oz.

PLEURAL CAVITIES.

There was no effusion of fluid.

The right lung showed no adhesion to the pleura.

The left pleura was adherent to the lung over the front and upper extremity: the adhesions were easily broken down but appeared somewhat old.

Both lungs were oedematous and congested: there were no signs of tubercle or of consolidation.

The Bronchi showed marked injection and congestion.

The bronchial glands showed no enlargement.

R. Lung - wt. 11oz.

L. Lung - wt. 10oz.

ABDOMENLiver.

The liver was small. It was adherent to intestine and firmly to the Diaphragm: also slightly to the Parietal Peritoneum.

General Appearance.

The liver was brownish yellow: the left lobe paler than the right. On the right lobe, anterior surface, there was a large cauliflower-like bulging; the gall bladder was small and collapsed. The bile duct was patent. On the under surface of the liver, on both sides around the gall bladder, there were several of the same irregular protrusions resembling tumours.

When removed, the liver weighed 20½ oz.

These raised areas show a lobular pattern, the lobules being yellow with dark red centres.

The "growths" described, were now seen to consist of a diffuse change, and involved two thirds of the right lobe of the organ: the surface was there mottled in appearance and irregular.

Section

The section showed the substance of the liver to be of a dark gamboge colour, granular, and following the lobular lines, the true liver substance having practically disappeared in these "diseased" tracks.

The lower surface of the left lobe, where incised, was of the same

appearance. The sunken areas showed numerous closely set grey portal systems in a mahogany ground. The raised areas on the surface corresponds to areas of hepatic tissue in which the lobules are large, soft and bulging, of bright yellow colour, and separated by narrow, slatey grey, sunken lines.

PANCREAS

The pancreas was adherent to the surrounding intestine.

The organ seemed slightly flabby, was stained like the other organs on the surface, but showed no signs of softening.

SPLEEN

The spleen seemed small, it weighed $2\frac{1}{2}$ oz.

There was a tiny extra lobule.

On section, it cut firmly and seemed normal.

KIDNEYS

There were adhesions around the right kidney.

The capsule stripped easily. The naked eye appearances were practically normal. The cortex and papillae were well defined. Wt. $4\frac{1}{2}$ oz.

Left Kidney and suprarenal appeared normal - Wt. $5\frac{1}{2}$ oz.

STOMACH

There was nothing calling for note to the naked eye.

INTESTINES

Appeared normal.

MESENTERY

There were no petechial echymoses.

The glands were not visibly or palpably enlarged.

MAIN FEATURES OF NOTE TO THE NAKED EYE.

1. Liver Changes. Small size, adhesions and cirrhosis with consequent loss of true liver substance.
2. Adhesions on

(a)	Brain Surface,
(b)	Around left lung,
(c)	" Pancreas,
(d)	" Right Kidney.
3. Bile staining of the whole body and internally of coverings of all organs.
4. Lack of Haemorrhages - usually associated with fatty changes.

Case 10.

C. G. Aet. 22. Complexion, Fair. Teeth, Good.

In contact 7 months.

History 17.2.16. Takes an hour from home to Danger Buildings Leaves home at 6.30 a.m. He takes some bread and milk before leaving and has breakfast at canteen in the Danger Buildings. He was quite well until about a week ago, then he began to have " pains in his inside " When he commenced to eat his food it tasted like T.N.T.

Present Condition. Slight cyanosis, somewhat anaemic, no jaundice. Pulse 100, good. Is suffering from acne. He has never vomited but is somewhat constipated. Has no pains in chest or legs. Has slight headache in mornings. Treated with Mist. Ferri et Ammon cit. and recommended for removal from contact with T.N.T. for 4 weeks.

Case 11.

B.W. Aet 15½. Complexion , Fair. Teeth, Good.

In contact 4 weeks.

History, 17.2.16. Takes ¾ hour from his own house to the Danger Buildings. He leaves home at 6 A.M. Has breakfast of eggs and bacon before leaving. Next meal " which he brings with him " is at 1 o'clock. Has been working for four weeks, filling small exploder bags with T.N.T. powder. He was quite well until last night, when in bed he felt pains in stomach. He did not vomit. Supper usually consists of fish, fried potatoes and green vegetables.

Present Condition. Very slight cyanosis, very anaemic. Pulse 72, slight rash at angles of mouth and one or two patches on chest. Tongue is clean, no pains in chest or legs. He had headache this morning and " stomach is still bad ". He does not feel, very strong to-day. Treated

~~XXXX~~

with Mist. Alba in the morning and Mist. Ferri et Ammon. Cit. T.D.S. Ungt. B. & Z. for face. Recommended for permanent removal from contact with T.N.T.

19.3.16. Still complains of pains in stomach, but is able to do his work. Is still very anaemic and is now getting Mist. Ferri et Ammon. Cit. with Liq. Bismuthi m.15 in each dose. Rash improving.

Case 12.

L.R. Aet. 49. Complexion, Fair. Teeth, Bad.

In contact 2 weeks and 2 days.

History. 18.2.16. In lodgings half an hour from Danger Buildings. Never takes a good breakfast in the morning; usually a cup of tea and a tea cake. This week has been going to dinner at the canteen at 11.20 A.M. From 15th Nov., 1915, to 31st. Jany., 1916, has been working on nitrate of ammonia. Was never ill except for a "touch of gastritis" (an old complaint) and then off work for four days.

On Feby. 1st he went to work on T.N.T. and was assisting at the coppers for two days. (1st & 2nd Feby.) then he went on to filling shells for 3-4 days (3rd, 4th, 5th & 6th Feby.) then for another two days on the coppers. Afterwards filling shells for 3 or four days. On the 14th Feby. he was on the coppers, and was there until the 18th Feby. He ~~XXXX~~^{wears} a respirator when on the coppers. At first he found that the coppers did not affect him very much, except for the taste of T.N.T. in his mouth. He vomits every morning and "brings up blood" but he has always done this (owing to gastritis) before he came to his present work. He first noticed a rash on his forehead on 16th Feby. On 17th he began to have frontal headache and some of his work mates noticed a rash on his wrists. His bowels are quite regular.

Present Conditions.

Well marked cyanosis. Very anaemic. No jaundice
 Pulse 100. No pains in arms or legs. No tightness of chest
 He has an acute dermatitis on the exposed portions of face
 especially on forehead, sides of nose and at back of ears.
 There is also a slight rash on wrists, especially the flexor
 aspects: the rash itches at times. The eyes are not affected.
 Heart sounds normal. Put on injury list and treated with
 Ungt.

~~Mist.~~ B & Z. Also

R.

Liq. Bismuthi	dr. 6
Ferri et Ammon cit.	dr. 1
Glycerin	dr. 4
Aq. ad	oz. 6

Sig. oz. $\frac{1}{2}$ T.D.S. ex aq. p.c.

23.2.16. Still complains of headache and vomiting. Face
 and arms improving. Mist. repeated.

25.2.16. Still complains of headache. Vomiting has ceased
 since the 24th.

1.3.16. No headache, no vomiting. Hands and face very
 much improved. Anaemia less. Mist. continued.

6.3.16. Much better

7.3.16 Allowed to resume duty, but permanently removed
 from contact with T.M. T. as he is over the age limit and
 also suffers from gastritis.

Case 13.

H. D. Aet. 28. Complexion, Fair, Teeth, Fair.

In contact 8 months.

History. 19.2.16. Takes $1\frac{1}{2}$ hrs. from home to Danger
 Buildings. Takes breakfast at 6 A.M. consisting of egg,
 bacon, tea, bread and butter. Sometimes he gets cocoa before
 commencing work, but as a rule he goes on until 1 o'clock.
 He "drinks a lot of boiled milk" Yesterday he had a "tight
 feeling" in the stomach. He "seemed like bursting" when
 he took a breath.

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Present Condition Marked cyanosis, slight anaemia, no jaundice. Pulse, good, 72. Pain in stomach, head dizzy. No vomiting. Bowels move every day. Treated with Ferri et Ammon. Cit. Recommended for removal from contact with T.N.T. for 4 weeks.

Case 14.

M.R. Aet. 32. Complexion, Dark. Teeth, good but very dirty. In contact 5 months.

History, 19.2.16. Lives $1\frac{1}{2}$ hours from Danger Buildings. He works for one week on the coppers and then 2 weeks at filling shells. Eats nothing in the morning until he arrives at the Danger Buildings, then has a cup of cocoa and some bread and butter. He takes nothing else until 1 o'clock. He feels somewhat sick after eating, but does not actually vomit. 3 weeks ago he felt "tightness of chest" and shortness of breath in walking. It has been getting worse but he has never visited the surgery. He was seen by M.O. at Danger Buildings last night who advised him to come up this morning.

Present Condition. Slight cyanosis, marked anaemia. Pulse, good, 80. No jaundice. No pains in arms or legs. Heart, normal. Treated with

R.
Liq. Bismuthi dr. 6
Mist. Ferri et Ammon. cit ad oz. 6

Sig. $\frac{1}{2}$ oz. T.D.S.

Recommended to be removed from contact with T.N.T. during 4 weeks.

Improving.

Case 15.

M.J. Aet. 14. Complexion, Pale. Teeth, Good.

In contact 9 weeks.

History. 21.2.16 Takes breakfast of cocoa, bread and jam.

Has no other food until 1 o'clock. Works on filling small bags with T.N.T. powder. Two or three times since commencing work on T.N.T. he has felt sick, but did not take much notice of it. Two or three days ago he began to have pains in his stomach.

Present Condition. Slight cyanosis. Anaemia. Pulse 112 Shows signs of contact with T.N.T. but evidently now suffering from chill. Is therefore advised to see his own doctor.

Case 16. St.J.

Aet. 15. Complexion, Pale. Teeth, Good.

In contact 7 months.

History. 25.2.16. Lives $\frac{1}{2}$ hour from Danger Buildings. Takes breakfast at 6.30 a.m. consisting of tea, bread and butter and occasionally an egg. Does not take any cocoa before work. He is employed on filling small bags with T.N.T. powder.

Four months ago he complained of "pains in his inside" for which he was treated (but not removed from contact).

Four or five weeks ago he again came up and was treated and removed from contact with T.N.T. for 3 weeks. After this he went back to work on T.N.T. He had pains when he went to bed last night. The night before this he was " sick " but had no pains.

Present Condition. No cyanosis. Very anaemic. No jaundice. Pulse, Good, 92. No pains in legs or arms. No rash on skin. His bowels are fairly regular. Appetite rather poor. He is a very pale, anaemic boy and-is being treated with Ferri et Ammon. Cit. and removed from contact with T.N.T. permanently.

Very much improved under treatment.

Case 17.

D.E.G. Aet. 38. Complexion, Fair. Lost all teeth but wears dentures. In contact 11 days.

History. 28.2.16. Takes $1\frac{1}{4}$ hrs. from home to Danger Buildings Takes a cup of cocoa before leaving home, at 4.45 A.M. He has a good breakfast at 6.15 a.m. in a coffee shop before starting work. Has early dinner at 10.30 A.M. Tea at 4 P.M. Has been working in empty shell store as labourer since 10th Jany. and was quite well all the time.

On 17th Feby. he commenced work in the boiling-out house on "clean side" i.e. where the cans (in which liquid T.N.T. is carried.) are cleaned and boiled.

Bowels are also quite regular.

On 26th Feby. in the evening after work he felt an itching on the back of hands and neck, but no rash was visible; otherwise he felt quite well and took his food well, etc.

On 27th the itching on his hands increased, and he saw a rash on the back of his hands. His land-lord saw a rash behind his ears. He felt "queer and his head felt queer and hot". He took his breakfast quite well and his appetite was unaffected. He had very severe headache at this time.

At 4 P.M. he saw his doctor who prescribed a lotion for him.

Present Condition. 28th. Slight cyanosis and is somewhat anaemic. No jaundice. Pulse, good, 64. Acute papular dermatitis present on backs of hands and wrists, ^{extending} From heads of metacarpals to about middle of forearms. Also rash on neck, especially behind his ears and slight rash on forehead. He says that his face "feels drawn" His headache has disappeared but he "still feels queer in himself" and drowsy. Has no pains in chest, stomach or legs. Put on Injury List and treated with Ferri et Ammon. Cit. and Ungt. B & Z.

29.2.16 Rash much the same, feeling somewhat better.

2.3.16 Rash is getting better on hands and at back of ears. Forehead almost all right.

4.3.16. Rash does not seem to improve much on right hand. (He uses his right hand most). Given Mist. alba oz. $\frac{1}{2}$ every morning and R. Lotio, calamin.

6.3.16. Rash much better, anaemia, less. Feels much better.

9.3.16 " " " " " " " " "

Allowed to resume duty on 10th March. Removed from contact with T.N.T. for 4 weeks.

Case 18.

T. A. Aet. 15 $\frac{3}{4}$. Complexion, Fair. Teeth, Good. In contact 8 months.

History 27.2.16. Takes somewhat over an hour from his lodgings to the Danger Buildings. Always takes a good breakfast before leaving home, but does not take cocoa before commencing work. On morning of 24th going home from night work he felt a "pain in his stomach" around the umbilical area. He took some food and went to bed but could not sleep because of pain. In the afternoon he got up, took a dose of Epsom Salts, but did not take any food. At 5.30 P.M. he left home for night work. Commenced work at 6.45 P.M. He had pain in stomach while at work and felt sick but did not vomit. He ~~was~~^{tried} to get an action of the bowels but they would not act. At midnight the pains suddenly got worse.

This was the mid-night dinner hour but he ate no food.

He came up to the surgery the next morning but he did not wait to see the doctor. When he went home he went to bed but was unable to lie still. He stayed in bed until

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3.30 P.M. Then he got up and came to the surgery at 6.40 P.M. He had a slight action of the bowels before this and felt faint. While being examined he again felt faint and had to go out. He then had a good action of the bowels. He got a "pass out" and went home and put his feet in hot water with mustard and went to bed. He felt very ill when he got up in the morning of 26th. He took two cups of tea but no bread as he felt he could not eat, because "he had a funny taste in his mouth" He arrived here at 10.30 A.M. He was seen at 11.30 A.M. in a collapsed condition. His pulse was very feeble and he looked extremely ill. He was at once put to bed in the surgery and a blanket put over him. ~~XXXXXXXXXX~~

Strychnine gr. 1/60th injected. He was then removed to hospital on stretcher, and when he arrived there he was semi-conscious. He was immediately put to bed with hot bottles and hot milk given. Temperature on admission 98. He was much better that after-noon. Exam. 27th. 2.16. Is looking much better, colour much improved. Pulse, good, 84. Heart, nil. Lungs, nil. Liver, no enlargement. Slight icteric tinge in conjunctivae. No cyanosis, no pains in legs. Has still a slight pain in stomach, which comes and goes. Has been receiving milk diet until to-day when he received full diet and was able to take it well..

28.2.16. Pulse 76. Temp. 99.4. Complained of throat feeling dry, but nothing abnormal there on examination. No headache, no pains in legs, no sickness. Had slight pain in stomach in the morning but no pain at time of examination.

29.2.16. Complains of feeling sick. Temp. slightly raised Put back on milk diet.

2.3.16. Feeling much better and put on full diet.

4.3.16. Out of bed and still feeling well..

6.3.16. Discharged from hospital.

7.3.16 Complained of slight pains in stomach.

9.3.16 Colour, good. No anaemia. No cyanosis. No pain in stomach, etc.

Allowed to resume duty on 10.3.16, but recommended for permanent removal from contact with T.N.T.

29.5. 16. Was seen at surgery on this date when he came because of injury to eye. He is not now employed on T.N.T.. After one month at his present work, he "came over funny" again. His Stomach "felt queer" and he was "doubled up" He did not ~~go~~^{go} off work and the symptoms disappeared. He has had ^{no} recurrence.

Otherwise he is quite well and is on a trimming machine, but says he would prefer T.N.T. work.

Case 35.

C.W. Aet. 32.

History 13.5.16. Was painter until about 2 years ago Started work here about 9 months ago filling shells with melted T.N.T. and also on the coppers. He worked 6 months at this and during this time he never felt ill or made any complaint. Then he was put on T.N.T. powder weighing and pressing it. He felt quite well on this until about fourteen days ago, then he felt pains in abdomen. He also had nausea and vomiting. Bowels have been fairly regular all the time. He has had no pain in his head, but about a week ago he began to have a "thumping" sensation in forehead and temples. He also felt giddy but did not fall down. His appetite has been very good until this last week when it became bad. He suffers markedly from pyorrhoea alveolaris

Pulse, 96. Poor. Very anaemic and blue almost white lips. Tongue clean but tremulous. He looks very ill. Urine Sp.gr. 1020. No alb. , no sugar, some bile present. Blood film, ~~now~~ poikilocytes. He was admitted to hospital on 13th May, 1916. Treated with

R.

Liq. arsenicalis m. 48
Mist. Ferri et Ammon. Cit oz. 6

Sig. oz $\frac{1}{4}$ T. D.S. ex aq. p.c.

Improved somewhat in hospital and was sent out with a view to his going to the country. He was discharged from hospital on 1st June. Just before he left an examination of the blood showed that there was very great variation in the R.B.C. several smaller and several ^{larger} ~~smaller~~ than normal being seen. The films showed scantiness of R.B.C. and relative absence of leucocytes, no poikilocytes and no nucleated reds. He got much worse and was readmitted to hospital on 6.6.16 7.6.16. He is on fish diet, eggs, apples and green vegetables. Slept fairly well, but does not feel bright. 8.6.16. Mist. alba given at 5 A.M. Complained of nausea at 7.30 a.m. and vomited at 8 a.m. and has had feeling of nausea several times since. Has not vomited since 8 a.m. On milk diet for the present with tea, bread and butter and pudding. Mist. sod. sulph. given oz $\frac{1}{4}$ T.D.S. 9.6.16. R.B.C. 700,000. Haemaglobin 20%. Slept all night no vomiting and appears comfortable. 10.6.16. Comfortable day, no nausea. Took nourishment well. 11.6.16. Slept well last night. Urine 1012, no alb., no sugar, no bile. No nausea, no vomiting, no pain in stomach. Has still pain in both temples, a "thumping" sensation. This does not trouble him so long as he lies still, but if he sits up then it commences to pain him. No pain in the eyes. Tongue pale and coated with whitish yellow fur. Still profoundly anaemic.

Heart, apex beat in sixth interspace mid-clavicular line.
 Heart sounds closed. Bruit de diable well marked.
 Lungs, nil. Liver, neither enlarged nor contracted.
 Spleen, not palpable. No tenderness over liver or in any
 part of abdomen. Temper. 98.4, Pulse, 100. Resp. 20.

15.6.16. R.

Fe. sulph. gr. 80
 Liq. arsenicalis ~~gr.~~ 48
 Tr. columbae dr. 2.
 Aq. menth. pip. ad oz 8

Sig. oz. $\frac{1}{4}$ T.D.S ex aq. p.c.

17.6.16. R.B.C. 900,000. Hb. 15%. Colour index .83

22.6.16. Fish diet. Green vegetables, no potatoes, salad,
 fruit, biscuits and cream. Benger's food. Tea, bread and
 butter.

23.6.16. Slept very well during the night, not so restless.
 Temp. 98.4. Pulse 100. Resp. 24.

R.B.C. 1,200,000 Hb. 15%. Colour index .51.

24.6.16. Slept fairly well during the night. Does not seem
 very bright this morning. Complains of headache. Took very
 little dinner to-day.

25.6.16. Fairly comfortable.

26.6.16. Had chicken for dinner to-day. Had burning sensa-
 tion in stomach in evening.

27.6.16. Comfortable to-day.

28.6.16. R.B.C. 780,000. Hb. 15%. Colour index .9

29.6.16. Pulse 104, Resp. 20. Temper. 98.4. Still very
 anaemic. No icteric tinge in conjunctivae. Thumping sensa-
 tion in head continues. Bruit de diable well marked.

Haemic murmur heard in mitral area (was not heard before)

No nausea, no sickness, no pain in stomach, no tenderness
 in abdomen. Fairly comfortable but complains of headache.

Had a troublesome cough towards evening. Mouth washed out
 with pot. permang.

92. Histories of Case.

30.6.16. Slept well during the night. Cough less, Temper. 98.4, Pulse 100. Resp. 24. Haemaglobin 15%.

~~30.6.16.~~ 1.7.16. Headache continues, but takes his food well.

2.7.16. Slept well during the night. Still very pale and anaemic. Temp. 98.4, Pulse 100. Resp. 24.

4.7.16. Slept very little during the night. T.98.2. P.104 R. 24. R.B.C. 900,000. Hb. 15%. C.I. 0.83

5.7.16. Fairly comfortable to-day. Still very anaemic and has thumping in head.

6.7.16. Not very well to-day. Not taking food well. Still complaining of thumping in head. Somewhat brighter in the evening. T. 98.6, P. 100, R. 20.

7.7.16. Slept well during the night, 8.30 a.m. vomited fluid, then became pulseless and was of a very bad colour. He improved later. Has been very breathless all day (air-hunger) Pulse, very bad at 5 P.M. Hypodermic. Strychnine gr. 1/100th. Digitalin gr. 1/100th given. Pulse improved took his food fairly well. Morning T. 97.6. Evening T.99.8. Pulse 130, Resp. 20.

8.7.16 Slept fairly well until 4 A.M. then became restless and vomited. He vomited again at 6 a.m. and complained of severe pain in lumbar region. Very breathless.

Hypo. Strych. & Digitalin aa 1/100th gr.

Because of his breathless condition oxygen was given for 5 mins. every hour. This somewhat relieved him.

Morning T. 97. P. ? Resp. 34.

Evening T. 99. P. 140 Resp. 41.

Very restless at 6 P.M. and tried to get out of bed.

Breathing very laboured and oxygen continued at intervals.

Hypo. Strych. & Digitalin given. Delirious at times. Pulse uncountable.

9.7.16 Died at 1 A.M.

CW. v. Post Mortem.

Macroscopic.

Rigor Mortis was present in the extremities and jaws. The body was that of a well developed, well nourished muscular man.

The skin was pale of a somewhat old ivory tinge. There was profound anaemia, the lips being pale blue almost white. The conjunctivae were white and no jaundice was present. No purpuric spots were observed on the skin.

On opening into the pleural and abdominal cavities the muscles were intensely red in colour.

Petechiae were present in the mesentery, the left domes of the diaphragm, parietal and visceral pericardium, mucosa of the pharynx, the body of the stomach, mucosa of the urinary bladder, visceral pleura of diaphragmatic surfaces of the right lung, the renal pelves and the lower part of the ascending colon.

There was a thin, freely movable, film of red clot (1.5 x 1 cm. diameters) in the subdural space over the right upper Rolandic area. There was a little blood in the subarachnoid space over pole and inferior surface of the left temporal lobe also the outer surfaces of the antero-inferior part of the left frontal lobe, the lower part of the right ascending frontal convolution, both occipital poles, the upper part of the left ascending frontal convolution and the posterior extremity of the left superior frontal convolution.

Petechiae were also present in the leptomeninges all all over the cerebellum.

A few petechiae were observed in the substance of the cerebrum and several in the cerebellum and pons.

The Brain weighed $41\frac{1}{2}$ oz. it was oedematous and very anaemic.

In the Pericardium there were 3 oz. fluid and on the visceral pericardium there were some milk spots.

The Heart weighed $16\frac{1}{2}$ oz.

The valves were thin and transparent with slight atheroma but were competent.

The myocardium was pale chocolate in colour and showed severe, diffuse, fatty degeneration with fatty tigering of both ventricles. The myocardium was also anaemic.

On opening the pleural cavities there were 3 oz. of fluid in each. There were a few delicate fibrous pleural adhesions over the outer surface of the left lung. These broke down easily. Both lungs were oedematous and showed great anaemia and there was oedematous collapse of the posterior border of the right lower lobe.

The Liver was rusty brown in colour and weighed $48\frac{1}{2}$ oz. It was anaemic together with iron pigmentation and showed fatty degeneration.

The Spleen weighed $2\frac{3}{4}$ oz. and was of normal appearance with slight oedema.

The Kidneys were enlarged, anaemic and oedematous and had parenchymatous degeneration.

There was mucous catarrh of the stomach at the pylorus, and some brownish fluid in it with some haemorrhages.

There was bile stained chyme in the upper portion of the intestine and faeces in the lower portion.

On sawing through the long axis of the right femur there was fatty marrow throughout, with exception of a few small pink areas in the spongiosa of the neck.

In the marrow of the right humerus there were a few small vascularised patches. There was mottled fatty and red marrow in the bodies of the lumbar vertib^ae and in the ribs.

The blood was watery and red in colour and ^{there} was very little post portem thrombus.

The following is the Microscopical report.

In the Liver the centres of the lobules show a fatty degeneration and necrosis, which has the characters of a degeneration due to anaemia; the hepatic cells in the peripheral zones are loaded with granules of free iron.

In the Kidneys there is parenchymatous necrosis and degeneration in which fatty degeneration plays a small part. There are a few nucleated red corpuscles and a very few myelocytes in the spleen and lymphatic glands, but there are no definite areas ⁱⁿ ~~and~~ these organs of myeloid activity.

In the Spleen there is a considerable number of cells containing coarse granules of iron pigment but extremely few phagocytes containing erythrocytes.

In the Brain there is fatty degeneration of the endothelium of capillaries.

In sections of the marrow of the femur, humerus and the body of a lumbar vertebra such blood forming marrow as is present shows a relative excess of erythroblastic activity and a great decrease ~~and~~ in the number of megakaryocytes.

In the marrow there are numerous plasma cells and large phagocytes. The latter contain pyknotic nuclei, erythroblasts, erythrocytes and coarse granules of iron pigment.

In the blood I found a few normoblasts, and in the tissues and blood a few megaloblasts.

Case 45. Fatal.
C. P. Aet. 37.

16.11.16. Admitted to hospital suffering from shortness of breath, slight abdominal pain and constipation.

The pallor is extreme.

History taken 17.11.16.

Has been employed here for 15 months. Previously he was a builder's labourer. He served 12 $\frac{3}{4}$ years in the Royal Marines. When he came here he was employed in the Danger Buildings and has been there ever since.

He has never before been laid up in bed and declares that he had a fair colour.

About 6 months ago he was told he did not look so well as formerly.

The journey from his home to where he works takes about 1 $\frac{1}{2}$ hours.

He has noticed for two or three weeks, not more, that he was short of breath on even slight exertion.

His pale face attracted the notice of the M.O. during the inspection of the T.N.T. workmen. C.M. P. was told to attend at the surgery on the following morning. He did so and was admitted to hospital as above stated. C.P. was extremely pale on admission, but after a night's rest he looks better and says that he feels better. He says that he has been much troubled with constipation, but his bowels have been well moved since his admission.

He says that he feels rather hungry.

Temp. subnormal. Pulse 116, equal in the two radials.

Heart sounds are normal. There is no haemic murmur.

Lungs. Breath sounds normal, no dulness.

No increase in the area of dulness either of liver or spleen. Teeth in good condition. His conjunctivae are very pale, the lips more so.

The Urine is negative to Webster's test.

18.11.16

C.P. slept very well. He felt all right on waking but on going out to wash himself he returned and bent down to put some coal on the fire which is near his bed. He felt giddy and sat on the corner of his bed. He had pulled up his feet involuntarily and he felt as if he was tumbling somersaults. Some one pulled his legs down, he lay down for a few minutes, during which time his heart was beating quickly. Afterwards he felt all right.

Blood Count.

R.B.C. 1,637,000. Hb. 35%. C.I. 1.1

Leucocytes 1,400. per cm.

Polynuclear neutrophils	20
" " eosinophils	Nil
Small lymphocytes	50.5
Large do.	26.5
Large hyaline cells	3
	<hr/> 100.0

The red cells are practically normal. There is very slight change in size (a few small cells present). Poikilocytes extremely scanty, nucleated red cells absent.

His pulse to-day at 11.15 a.m. is 75. He complains of a very slight headache, and he has been put on iron and arsenic in small doses.

19.11.16. Little change in appearance but says he is feeling better.

20.11.16. Says he had a particularly good night and enjoyed his breakfast. Pulse 80. There is no headache and he has not noticed that he is short of breath to-day.

21.11.16 Pulse 75. He slept very well, but in getting up to go to W.C. he felt giddy. He felt all right after getting back to bed. The sister in charge makes complaint of his getting up when no one is present, and he has been told not

to get up suddenly. He finds on waking in the morning that there are small clots of blood in the interstices of the teeth, which he picks out with his fore-finger and places on his handkerchief. They show on the handkerchief as stringy black clots. He does not observe this during the day. He says that he has a slight mist before his eyes, but has no headache.

22.11.16 Has slight headache. He slept extremely well. Pulse 70. There is apparently no change in his appearance since yesterday. He has no abdominal pain and feels quite ready for dinner which is due in about 20 minutes.

His cardiac sounds do not show any variation. It is to be noted that the chief change in his condition is the gradual slackening of the pulse rate.

23.11.16. Has still a slight frontal headache.

24.11.16 The slight headache of yesterday is at present unaltered.

His pulse rate was 75 at the first counting, 72 after a few minutes conversation, and during auscultation had become still ~~slower~~ slower. No enlargement of the spleen can be detected and ^{the} area of liver dulness remains unchanged.

The proportions of liq. ferri perchlor and liq. arsenicalis in his medicine has been altered to m. 1 and m. 3½ respectively in each dose (from yesterday) and he is from to-day to be allowed a glass of stout with his dinner.

25.11.16. No change.

27.11.16. Says that he has had a headache since waking this morning which is now passing off. Yesterday he had a slight headache on waking which soon passed off, but to-day the headache has been more severe and of longer duration. His appetite continues good.

28.11.16. Less headache this morning and it passed off very soon. There were none of the little clots of blood between the teeth that he had observed before.

Pulse 72. Says he feels a " lot better " to-day.

29.11.16. Slept well but had headache on waking. Pulse 76. His temp. chart shows a slight and gradual rise during the last three days reaching 99.6 to-day at 11.10 a.m.

30.11.16. Says that he feels better to-day. Practically no headache on waking. Temp. has fallen to 99 this morning. Conjunctivae seem to be improving in colour. Hands seem less waxy. Pulse 78.

1.12.16. Severe headache this morning, appetite less keen. Still small clots in lower teeth. Temp. 99.8, Pulse 82.

2.12.16. Some headache on waking. Temp. 98.8, Pulse rate varies between 82 and 88 according to the movement in the ward, any little bustle and it goes faster.

4.12.16. Still slight rise in temp. which cannot be ascribed to sepsis of the mouth as his teeth are in good condition and he is very particular in cleaning them. Patient ~~appears~~ remains very anaemic in appearance. He is cheerful and still a good appetite.

6.12.16. Had a fair night but was disturbed by clots forming on the gums of the upper jaw.

8.12.16. Had a cup of tea about 5 a.m. which was very soon and very suddenly rejected. He, however, took his breakfast about 7 a.m. and enjoyed it.

The skin under his eyes hangs rather in folds, suggesting that earlier in the day there had been some degree of oedema.

13.12.16. Not much change since the last note. Says that he feels better but there is a slight tenderness in the region of the appendix. The pain was for the first time

since admission. Somewhat depressed to-day. Temp. normal pulse 89. No sickness and thinks that he will be able to eat his dinner. Blood again examined and showed no nucleated red cells and relative absence of leucocytes.

Some raw meat shredded given to-day.

16.12.16. About 3.30 a.m. the patient had some bleeding from the nose. He says that he wanted to blow his nose and a clot came down. There has been some oozing since. Instructions have been given that he is to have a jacket on and be allowed to sit up in bed.

17.12.16. The epistaxis though slight still persists and in consequence his left nostril has been plugged with sterilized ribbon gauze dipped in adrenalin.

Was very ill and thought to be dying during the night.

18.12.16. C.P. looks apathetic. There has been slight vomiting, epistaxis has stopped; the patient seems to be gradually sinking. To be given brandy and milk.

19.12.16. On 17th at 6.30 p.m. the patient's temp. rose to 100.5 but has since remained lower than 100, chiefly moving from normal to 99. Pulse 105.

There is no difficulty in respiration, but has a slight cough rather suggestive of oedema of the bronchi.

20.12.16. Has had slight vomiting this morning but cheerful and making no complaint. He does not care for the milk and brandy, as it seems to make him worse.

23.12.16. Seems brighter than before. ~~Is~~ being fed chiefly on bread and milk.

24.12.16. Seems less drowsy than formerly.

26.12.16. C.P. was yesterday (Christmas Day) quite happy and cheerful. The sister says that he was the brightest patient in the ward. He has been lying on his right side, and in consequence there is slight oedema of that side of his face, which makes a slight change in his appearance.

28.12.16.. Seems less attentive to his surroundings and looks apathetic. There has been considerable oozing of blood from the gums. He still speaks cheerfully.

30.12.16. C.P. begged to be allowed to be present at the concert given to the patients ^{in the ward.} He quite enjoyed it but seemed to be rather exhausted afterwards.

31.12.16. Looks very ill and was very drowsy.

1.1.17. He looks better and describes himself as feeling better. Has a slight catarrhal cough. Pulse 96, regular.

2.1.17. C.P. has slept badly, being disturbed by blood oozing from his gums. Pulse 102.

4.1.17. No apparent change.

10.1.17. Says that he feels a "lot better" It is observed, however, that his breathing is rather more embarrassed even without any muscular movement. Pulse 120.

11.1.17. C.P.'s face is of a waxy paleness, but he says that he feels "much better"

12.1.17. Vomited this morning. Pulse 98.

16.1.17. Pulse in right radial difficult to find, rate is 102.

18.1.17. When seen last night at 11.15 p.m. he was slightly delirious and restless, and the restlessness continues this morning. He still lies on his right side, the head supported on his hand, and is continually making slight movements of his hands and arms.

19.1.17 C.P. breathes with difficulty and looks as if he is dying. For his relief oxygen for a few minutes every hour has been ordered.

20.1.17. C.P. died at 12.30 this morning.

C. P. Post Mortem.

Macroscopic.

Rigor mortis was present on the extremities and jaws. The body was that of a slightly built, muscular man and was well nourished.

There was profound anaemia and no jaundice.

Purpuric spots were observed in the skin of the abdomen and left chest. These were of a blue colour, also red purpuric spots on the left hand.

There was haemorrhage into the conjunctiva and iris of the left eye.

On opening into the body it was seen that the muscles were deep red in colour.

A few petechiae were seen on the posterior surface of the great omentum, and also on the outer surface of the parietal pericardium and in the areolar tissue of the posterior mediastinum. Petechiae were present in the muscle of the right dome of the diaphragm, serosa of the gall bladder, the renal pelves and the termination of the jejunum. There were minute petechiae in the mucosa of the centre of the oesophagus, and there was haemorrhage into, and thrombus upon the mucosa of the lower 12 c.m.s of oesophagus.

The Pericardium had numerous large petechiae in its visceral aspect over the right auricle and one upon the right and one

upon the left ventricle.

There were 4 oz. of clear fluid in the pericardium.

The heart ^{weighed} $15\frac{3}{4}$ oz. and showed diffused fatty degeneration and fatty tigering of the left ventricle.

The valves were thin and transparent and they were competent.

There was slight atheroma present. In the aorta there were some fatty patches.

In the Pleural Cavities there were 3 oz. of fluid in the right and 2 oz. in the left.

Both Lungs were very pale and showed greater oedema with oedematous collapse of the anterior extremity of the left lower lobe and the upper half of the posterior border of the right lower lobe. . There was one haemorrhage (0.4 c.m. diameter) in the right lung.

The Liver weighed 52 oz. It was a rusty brown liver , anaemic with fatty degeneration and iron pigmentation.

The Spleen weighed $2\frac{1}{4}$ oz. Had slight oedema but was otherwise healthy. The malpighian bodies were not visible in the smooth red pulp.

The Kidneys which weighed together $12\frac{1}{4}$ oz. were enlarged anaemic and oedematous.

The Stomach showed mucous catarrh also streaks of red and altered blood.

In the Intestines were bile stained chyme and faeces.

The Brain weighed $46\frac{1}{2}$ oz.

There were numerous minute petechiae in the ~~cerebrum~~ cerebrum and medulla which were also anaemic and oedematous. The Cerebellum had very numerous petechiae.

The right femur was sawn down the centre and showed a pale pink tinge in the fatty marrow in the upper 5 c.m.s. of the shaft.

Pale pink and yellow fatty marrow in the neck. A few pink areas (largest 0.3 cm. diam.) in the marrow of the shaft.

The right humerus showed pink marrow (? Haemorrhagic) in the lower 3 c.m.s. of the shaft,

There ~~was~~ very pale pink marrow in the lower 2/3rds of the manubrium, also in the sternum and in the bodies of the lumbar vertebrae.

In the ribs the marrow was mottled, pink and gray. The blood was watery and bright cheery red in colour.

There was very little post mortem thrombus.

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